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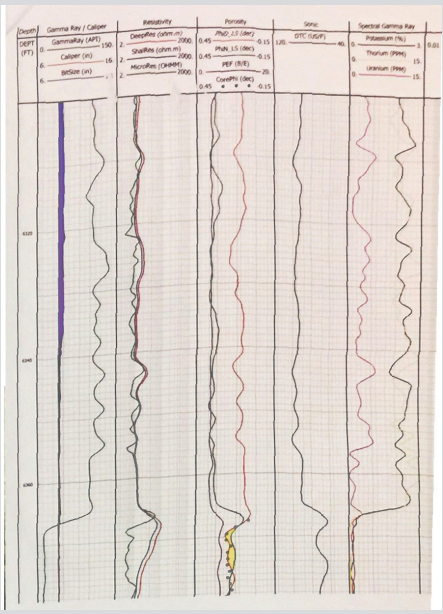
THE SPWLA TODAY NEWSLETTER

INSIDE THIS EDITION



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About the Cover

Photograph of slabbed core taken through the lower boundary of the Eagle Ford formation, across the Buda formation, showing the sharp change in the core and on the well logs across the lithologic interface between the two formation.

CALENDAR OF EVENTS

September 26-29, 2018

The 10th UPC International Symposium on New Well Logging Techniques
Theme: Current status and challenges in electrical logging
School of Geosciences China University of Petroleum (East China) Qingdao, China
www.spwla.org

October 11-12, 2018

The 24th Formation Evaluation Symposium of Japan
Sponsored by Japan Formation Evaluation Society
JOGMEC-TRC, Chiba
http://www.jfes-spwla.org/index.htm

October 29, 2018

Nuclear Logging SIG 2018 Technical Meeting
Frank S. Millard SPWLA Training Center
Houston, Texas
www.spwla.org

November 7–8, 2018

SPWLA Asia Pacific Technical Symposium 2018
Bogor, West Java
Indonesia
www.spwla-indonesia.org

June 15-19, 2019

SPWLA 60th Annual Symposium
The Woodlands Waterway Marriott
The Woodlands, TX
www.spwla.org

From the President

Zhipeng "Z" Liu
2018–19 SPWLA President
zliu@spwla.org

Dear SPWLA members and friends,

Happy Autumn! It is great to see many SPWLA local chapters and SIGs are back from summer break and setting up their action-packed agendas for the rest of the year. It is a great time to check our websites to mark your calendar for those events of interest to you. If you have not already done so, sign up for email alerts so you won't miss anything.

While you were having a great summer break, SPWLA has not stopped working. I would like to share some updates with you. Some of you may have noticed the SPWLA website received a facelift to make it more aesthetically appealing, functionally smoother and has a responsive design adapting to your mobile device. If you have not visited the website, go check it out.

Following implementation the new global privacy laws and regulations, SPWLA had to restrict the online member directory to SPWLA officer's use only. We fully understand that the member directory is a useful tool for many members to stay in contact and this decision was not taken lightly by the board. For those of you trying to locate a specific member, you are encouraged to try social media sites, such as LinkedIn and Facebook. You can still ask help from SPWLA business office.

I have some good news for our long-term members. SPWLA board has approved an initiative to award a certificate to long-term SPWLA members on every 5-year anniversary to recognize their seniority and contribution to the petrophysics community. In addition, a lifetime membership offer will be made available to make it easy for some of our senior members to stay engaged with SPWLA and continue sharing their vast amount of experience and knowledge with the society.

Last but not the least: Student Chapters. They are the future of SPWLA, our petrophysical community and our industry. Starting this year, SPWLA will allocate $500 of the general fund to each active SPWLA student chapter. This will assist student chapters with their meetings, event participation and activities.

From the Editor

Carlos Torres-Verdín
2018–19 VP Publications
cverdin@mail.utexas.edu

It is my pleasure and honor to introduce another excellent installment of *SPWLA Today*. I hope that our readers find it interesting, informative, and relevant. Many thanks to all contributors of this issue for their time and efforts to share their experiences with us. We are a diverse professional society in constant evolution, from the levels of discovery, research, and education, to the everyday field challenges. It is the diversity and professional challenges that we face that bring us together in multiple ways. Let the pages of our newsletter convey and extol the fabric of the SPWLA and let our members from all regions across the world communicate with us how the SPWLA provides a dynamic forum for personal and professional growth.

Please, be kind enough to e-mail us comments and suggestions to improve and adjust the *SPWLA Today*. Or better yet, please send us a column to share your passions and experience with the rest of our membership. The success of the SPWLA depends on all of us; everybody has voice and every voice counts! Thanks for your continued support.

Sincerely,
Carlos Torres-Verdín

Society of Petrophysicists and Well Log Analysts 60th
Annual Logging Symposium
The Woodlands, USA • June 15–19, 2019

CALL FOR ABSTRACTS

The SPWLA Board of Directors invites you to join us in The Woodlands, Texas, USA, June 15–19, 2019 to showcase your new technologies and innovations at the 60th Annual Logging Symposium.

The past few years have seen some dramatic changes in the oil and gas industry. Increasing production from unconventional resources and the eventual oversupply of oil based on the predicted high oil price and the reality of much lower prices has led to the need for more innovative technology. Of particular importance to the petrophysical profession is the rapidly increasing number of new wells where little or no log information is acquired. Ideas and new techniques using log data to derive answers that can improve completion design should be showcased.

We are soliciting papers in the following categories:

- **Formation Evaluation of Conventional Reservoirs -** *Case histories, new technologies and studies in clastics as well as carbonates covering low contrast pay, thin beds, fresh formation water etc.*
- **Formation Evaluation of Unconventional Reservoirs** *New technologies and techniques that are designed for the specific issues faced by operators in tight oil/gas formations and shale-rich formations.*
- **Machine Learning -** *Reservoir characterization methods that use core or other database inputs and outputs to train model-independent mapping functions for predicting reservoir properties from well logging data (supervised learning) or methods that use pattern recognition or clustering algorithms for quality control of data and/or extraction of useful reservoir information (unsupervised learning).*
- **Case Studies -** *New and interesting studies for evaluating reservoirs.*
- **Completion Petrophysics -** *Hydraulic fracturing modeling, rock mechanics, completion optimization, case studies in spacing studies and stimulated reservoir volume.*
- **New Borehole Logging Technology -** *Resistivity, nuclear, sonic, magnetic resonance, pressure/sampling, mud logging, imaging tool design and advancements in acquisition, processing, and data interpretation.*
- **Reservoir and Production Surveillance -** *Production logging, cement integrity, enhanced oil recovery, and formation evaluation technologies used to optimize reservoir performance.*
- **Formation Evaluation Behind Casing -** *Formation evaluation techniques based on measurements made in cased wellbores including those that integrate openhole data with cased hole measurements.*
- **Deepwater Reservoir Analysis -** *New techniques and studies that are applicable to the Gulf of Mexico and other deepwater environments.*
- **Petrophysics in Brownfields -** *New technologies and techniques applied to brownfield production and development. Making economic wells in older developed fields with high water cuts and low hydrocarbon flow rates.*

To get started

- Our members look for papers containing strong technical and innovative content at our symposiums.
- The information contained in your abstract is the basis for the acceptance of your paper into the technical program.
- Complete a separate online form for each abstract submitted. For multiple authors, the submission should come only from the designated corresponding author.
- Abstracts must be submitted no later than **Sunday, October 28, 2018.**
- Your abstract should contain 200–500 words. Do not feel obligated to use the full allowed length.
- Refrain from commercialism and focus on the promotion of petrophysics and formation evaluation.
- Digital abstract submission platform with new and improved functionality
  http://www.spwlaworld.org/abstract-submission

Notifications and important dates

- Acceptance of abstracts will be made in **December 2018** and you will need to prepare a manuscript for both oral and/or e-poster categories.
- If selected, your abstract will be published on the SPWLA Symposium website in **March 2019**.
- You will be required to submit a draft manuscript for the Symposium transactions by **April 29, 2019.**
- After submitting your draft manuscript it will go through a minimal technical committee review process to ensure clarity and to avoid commercialism.
- You will receive notice of the review results and your final manuscript is due on or before **May 13, 2019**.
- *Before submitting your final manuscript you must agree to meet all deadlines*. SPWLA has a policy of "No Paper, No Podium (or e-Poster)." Authors who do not submit their manuscripts by the due date will be removed from the program and replaced by an alternate paper.
- Your submitted abstract and your final manuscript must not differ. Before making revisions to the original content of the reviewed and accepted abstract you must seek approval from the technology committee.
- For questions, please contact Stephanie Turner at SPWLA, (+1) 713-947-8727 or email stephanie@spwla.org.

Please note that for the 2019 symposium we are considering running parallel sessions. The decision on whether or not to do this or will be made at a later date and will depend, in part, on the number of abstracts received.

We look forward to reviewing your abstracts!

James Hemingway
Vice-President Technology 2018–2019

SPWLA ASIA-PACIFIC TECHNICAL SYMPOSIUM 2018
7–8 November, Bogor, Indonesia

On behalf of the organizing committee, I would like to invite you to participate in The SPWLA Asia-Pacific Technical Symposium, which is being hosted by the SPWLA Indonesia Chapter on 7–8 November 2018, in Bogor, Indonesia. This conference, is intended for professional and academic delegates from a variety of technical backgrounds.

In its first year, the SPWLA Indonesia Chapter has regularly conducted technical discussions and workshops covering dozens of technical problems aligned to petrophysics-related issues. We strongly believe that the collaboration between academia and industry professionals will resolve the issues that have become quite complex over time. In this first symposium, whose theme is **Empowering Applied Petrophysical Concepts and Technology: Unlocking Hidden Potentials in Mature Fields,** the SPWLA organizing committee is seeking to focus on upside potentials and enhanced hydrocarbon life expectancy in mature areas, which requires the development of new concepts, ideas, and technology to provide answers to existing issues in petroleum exploration and production.

The symposium will include multiple technical sessions with presentations from operating companies, service companies, and university students. We anticipate that new technologies will be presented as well as new insights and concepts for dealing with current issues. There are more than 200 oil and gas companies in Indonesia involved in E&P of conventional and unconventional resources. The symposium offers a great opportunity to broaden networking among the professional community, as well as sharing knowledge and experiences. We fully expect that the combination of participants, stakeholders, speakers, and vistors will result in a vigorous exchange of ideas and inventions to address recent petrophysical issues encountered in mature fields that have not been fully developed. We also expect that the event will highlight the need for increased collaboration between industry researchers and academia to fully address the problems faced by industry.

The venue is located at Aston Sentul Lake, Bogor, which offers magnificent scenery including lakeside balcony views. Moreover, this venue only 3 km from the toll road that provides direct access to the Soekarno-Hatta International Airport and Jakarta. The beautiful city of Bogor is a creative hub where there is always something new to see and do. Hotels, venues, restaurants, and attractions are constantly updated and improved. It has the amenities of a modern city as well as the beauty of natural surroundings. Bogor will be a wonderful and convenient site for hosting the professional engineers, scientists, and academics who attend the 2018 SPWLA Asia Pacific regional conference.

Regards,
Aiman Haidar Shamlan
Chairman
Indonesia SPWLA Technical Symposium 2018

ASIA PACIFIC SPWLA TECHNICAL SYMPOSIUM

"EMPOWERING APPLIED PETROPHYSICAL CONCEPT AND TECHNOLOGY: UNLOCKING HIDDEN POTENTIALS IN MATURE FIELDS"

SPWLA INDONESIA CHAPTER

REGISTRATION IS NOW OPEN

Professional Member

Foreign : USD 250
Local : IDR 2,000,000

Professional Non-Member

Foreign : USD 350
Local : IDR 3,000,000

Student

IDR 1,000,000

Online Registration
http://bit.ly/SPWLAIND2018

Transfer the payment to
Bank BCA
Account name: Mellinda Arisandy
Account number: 522-501-6906

Send the proof of payment to
indonesia@spwla.org

indonesia@spwla.org | spwla_indonesia | SPWLA Indonesia Chapter | www.spwla-indonesia.org

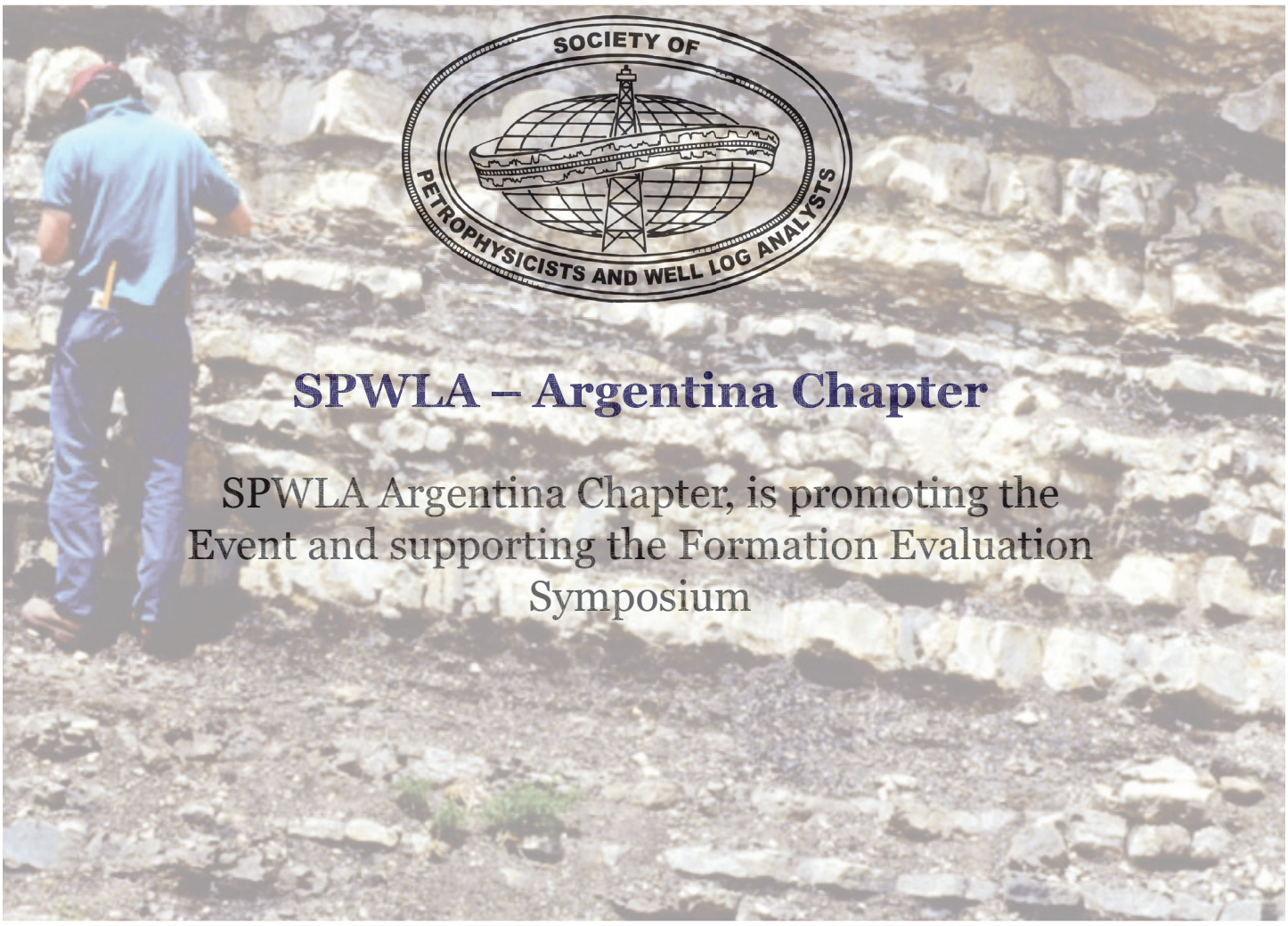
10th Hydrocarbon Exploration and Development Congress

Organized by the Argentine Oil and Gas Institute (IAPG) to be held between November 5th and November 9th, 2018 in Mendoza, Argentina

10° CONGRESO DE EXPLORACIÓN Y DESARROLLO DE HIDROCARBUROS

Energía y Sociedad, aliados inseparables

INSTITUTO ARGENTINO DEL PETROLEO Y DEL GAS



SPWLA – Argentina Chapter

SPWLA Argentina Chapter, is promoting the Event and supporting the Formation Evaluation Symposium

Petrophysics Data-Driven Analytics: Advancements, Challenges, and Opportunities
Summary of the SPWLA 2018 Spring Topical Conference Panel Discussions
Petrophysics Data-Driven Analytics: Theories and Applications
April 16–17, Houston Texas

Panel Leads and Moderators

Chicheng Xu (STC Chair), Aramco Services Company: Aramco Research Center – Houston

Siddharth Misra (STC Committee Member), University of Oklahoma

Attendees:

John Doveton (KGS), Michael Ashby (Anadarko), Han Jiang (UT Austin), Stephanie Brakenhoff (Discovery), Ingrid Tobar (Anadarko), John Douglas (Concho), Wei Yang (Xi'an Petroleum University), Guangzhi Liao (China Petroleum University, Beijing), Irina Borovskaya (SPWLA Houston), Ron Clymer (Devon), John Clymer (Oklahoma State University), Juan Pablo Gomez (Aera)

Areas of New Advancements

The confluence of new sensors, big data, high-performance computing, and advanced data analytics have contributed to large-scale applications of data-driven methods, which encompass data mining, artificial intelligence, and machine (deep) learning. Several areas in formation evaluation and log interpretation showcased new advancements of data-driven methods.

One immediate area of attention is the use of deep learning for integrating and interpreting image-type datasets, such as thin sections, core/outcrop photos, image logs, seismic cross sections, and maps. Another area of focus is to involve geologically consistent integration of operational database and formation properties followed by the application of data analytics to perform more effective and efficient field operations, such as drilling and completion, fluid and rock sampling, and data acquisition. Moreover, these methods can be useful in database reconstruction, noise filtering, and anomaly detection.

Another set of applications will be to minimize tedious, repetitive human efforts required for tasks, such as data cleaning, depth shifting, and horizon picking. In addition, data-driven analytics is particularly amenable to perform a few advanced reservoir characterization tasks, such as facies classification and rock typing.

Further, data mining of public databases can help in the identification of undiscovered and underused hydrocarbon assets. Data-driven predictive models that can transfer the statistical learning and mapping between reservoirs of varying rock/fluid types will greatly boost the implementations of these new methods. More test cases are needed to demonstrate the use of data analytics in large-volume data processing from various sensors to reduce the reliance on computationally heavy physics-based modeling methods.

Challenges

Data-driven methods require exposure to large datasets for purposes of extracting patterns and trends in the data and for testing their robustness and generalization capabilities. Small companies and academia often lack large and complete datasets. A big challenge involves getting over the hurdles put forth due to limited data quality and quantity. An industry-wide effort may be necessary to generate extensive large datasets of good quality, possibly masked, that can foster development of data-driven methods.

Without rigorous data preprocessing and quality control, the quality and relevance of predictive models deteriorate as datasets get larger. Equal emphasis should be placed on data cleaning, normalization, and calibration, which tend to be neglected during technical presentations and demonstration of various implementations. More work on data conditioning and feature selection can improve the robustness of the data-driven models. Data problems can sometimes originate from a lack of the following resources: well-trained data technicians, investment in data management, interdisciplinary integration, industrial standards and best practices.

Even when the data quality is ideal, applications of data-driven methods are challenging in the presence of heterogeneous and the multiscale nature of rocks, limited volume of investigation in reservoirs, real-time operational requirements, and highly dimensional data with large uncertainty. A standardized quality-control procedure for data-driven methods will go a long way to mitigate the aforementioned problems and improve the computational efficiency as well as the predictive capability.

Users of data-driven methods should perform and assess results from blind-source testing, offset well comparisons, ensemble approaches, and cross validation. From a petrophysical

viewpoint, these methods need to be geologically consistent for large-scale modeling, which mandates extensive training with field analogs and geological rules followed by populating the reservoir model with all the constraints extracted from the training data. The true benefits of data-driven methods will emerge after they are successfully applied to multiwell applications requiring integration of multiple disciplines and multiple sources of data acquired under varying reservoir conditions and rock types. New intelligent methods need to be developed so that the learning in one reservoir type can be transferred for applications in another reservoir type.

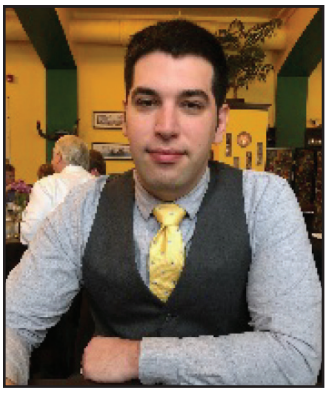
Software packages for log interpretation and formation evaluation may consider providing modules that can integrate with open-source data-analytics software and codes. The next generation of petrophysicists and log analysts should be trained through standardized courses, internships, software training, and good exposure to business cases. In the near future, logging tool and software development and design may be directly geared towards implementation of data-driven methods, which will require a completely new way of thinking that builds on our experience with physics-centered models and tools.

Machines or algorithms are still not intelligent enough to aggregate human experience and expertise. For the data-driven methods to become more intelligent, there is a need for collaboration among petrophysics, tool physics, and data-science domain experts. Such crossdisciplinary collaboration is necessary but remains a challenge.

Opportunities

- Increasing awareness of the potential use of advanced data analytics in the petroleum industry from management or executive level at various corporate levels – **good support**.
- Advanced algorithms (from other industries) and high-performance computing machines (GPUs) are becoming mature and ready to use – **technology ready**.
- A difficult business environment necessitates greater efficiency and lower cost – **right time**.
- The key is still our **people**: the oil and gas industry needs to train technical staff to apply the right technology at the right time to solve the right problems using the right data.

Regional Understandings – North America 1



Adam Haecker
2018–20 North America 1
Regional Director

Dear SPWLA Members

The website committee recently submitted a SPWLA page to Wikipedia. The page has some nice content about the chapters, the magazine, and the history of the SPWLA. However the Wikipedia editors are fairly stringent on newer articles. Despite the page having more content than our peer societies (SPE, AAPG, SEG) the editors of Wikipedia seem intent to flag it for "needs improvement." This is where you all come in. We need you to go to the Wikipedia page and submit edits. Anyone can do it, you don't even need an account. In the picture below I am logged out of my account. Don't think you need to be a master website designer to edit either, they have a visual editor that is basically like typing in MS PowerPoint or Word. They have made it exceptionally easy.

We especially need help on the history section. I have only been a society member for around seven years and have only been coming to the Symposiums since 2013. We need people who helped usher the society through the downturns in the 1980s and 1990s to weigh in on those tumultuous times. Here is the most important part. Please cite your sources if possible. We need more independent citations that are not on the SPWLA website. Any newspaper clippings, third-party mentions etc. would be most helpful. I also want to thank Eric Pasternack for writing a history of the SPWLA in 2009. Without that paper I would have been very lost in putting the history section together. So Please please, please if you are reading this go to the SPWLA Wikipedia page and contribute! The URL is below but I suspect it would be easier to just query it at the Wikipedia main page.
https://en.wikipedia.org/wiki/Society_of_Petrophysicists_and_Well_Log_Analysts

On to other business. The SPWLA Board met recently and approved a $500 budget for student chapters. Since student chapters often have a difficult time raising funds, we thought this might help them hold events and generate interest. If you are a student chapter officer, please contact the business office to get the funds sent. The student chapters asking for financial assistance is a recurring theme with the society. We decided it would be passed for this year but need to be renewed with next year's board. Hopefully this will help the student chapters grow.

Finally, in North America we are coming out of the summer months and starting to kick off technical talks at most of the chapters again. I encourage everyone to attend their chapter meetings and see the new crop of distinguished lecturers. A big thanks to all the chapter officers for updating your contact information and sending me your meeting schedules. If you are not

getting emails for your local chapters contact the SPWLA business office and they can put you in touch with your local chapter representatives.

Finally I am going to again plug the Japan symposium coming up in October, since I will be giving the keynote there. Hopefully in my next article there will be pictures from the trip.

Cheers!

Adam Haecker

Regional Understandings – Middle East and Africa

S. Mark Ma
2018–20 MEAI
Regional Director

Dear Colleagues,

To continue our discussion from the July Issue of SPWLA Today about the proposal for a Digital Mentoring Platform, and following the August 8 board meeting (the longest meeting I have ever participated in), I have set up a LinkedIn petrophysics mentoring group named Learning & Practicing Petrophysics Together (LAPT). If you are a young professional, you will definitely learn something valuable from the senior ones because we can share our learnings and mistakes made in our decades of working in this amazing industry. If you are senior professionals like me, you may also learn something useful from the young, as 'teaching' is the best way of learning. In addition, in the era of industrial revolution 4.0, the young can easily be the best mentors of anything digital. In either case, please join the LAPT group and experience yourself.

Stay tuned and enjoy the summer time!

The Invoice

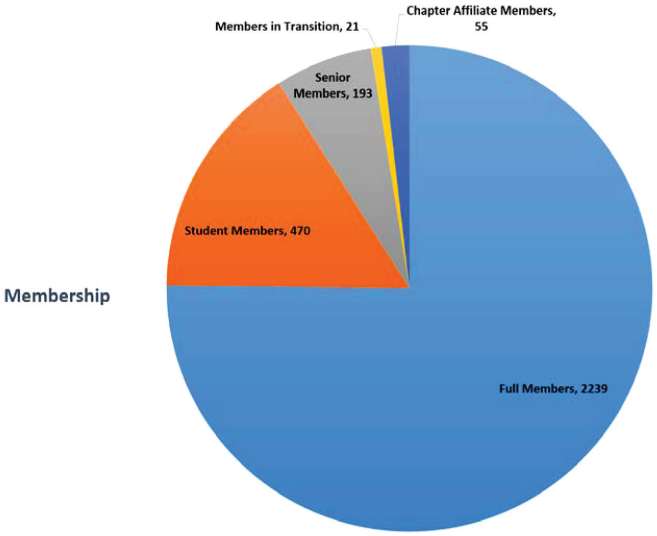
Jennifer Market
Vice President Finance

Overall, the finances of the society are getting brighter, though we have depleted much of our reserves due to the recent lean years, so we need to be careful to manage costs and consider ways to increase sponsorship in order to expand member services.

The 2018 Annual Symposium in London was a financial success, though the final numbers are still being tallied. We should be able to report an exact figure in the next newsletter.

Due to security issues, we have been advised to no longer print our actual financial numbers. A snapshot in percentages (of a fixed value) is shown below while any full, senior, or student member of the society may request the actual numbers by sending an email to VP-Finance@spwla.org.

Income/Profit		May 2016–April 2017 (%)	May 2017–April 2018 (%)	May 2018–August 2018 (%)
	Interest on Investments	1.25	0.44	-0.31
	Training Center Income	1.44	1.77	0.44
	Advertising Sales	6.45	6.45	1.48
	Membership Fees	23.25	23.77	2.65
	Symposium Profit (Iceland/OKC/London)	1.24	33.00	12.00
	Spring/Fall Topical Conference Profit	-0.84	2.59	0.00
	Student Membership Sponsorship (GE/BH)	0.38	1.00	0.10
	Royalty Revenue from OnePetro	6.85	7.53	1.66
	Other (Miscellaneous sponsorship, contributions, CD sales etc.)	3.53	0.54	1.02
	Total Income/Profit	**43.54**	**77.08**	**19.05**
Expenses	Staff and Facilities	31.28	30.04	10.03
	Petrophysics Journal + Newsletter (Expenses-Income)	22.06	22.58	3.36
	Contract Services (Lawyer, Accountant, Web Designer etc.)	6.42	3.46	1.79
	Operations (postage, printing software, employee training, bank fees etc).	6.94	7.54	2.26
	Student Chapter Support	0.25	0.06	1.66
	Distinguished Lecturer Program	2.43	2.18	0.48
	Board Travel Expenses	1.84	0.11	0.00
	Total Expenses	**69.38**	**65.85**	**19.57**



We would like to express our thanks to GE/Baker Hughes for their continued sponsorship of student membership.

Member suggestions for finance and membership, along with enquiries are welcome. Please contact me at VP-Finance@spwla.org. Thank you for your continued support in our society.

James “Jim” Hemingway
2018–19 SPWLA VP Technology
VP-Technology@spwla.org

I hope everyone has had a nice summer vacation and is ready for the 2018–2019 work year. The technology committee is assembled, and although it will not be that different from previous years, some notable changes have been made. These changes will hopefully encourage the industry to look at their decision-making process differently. I have also tried to add members from outside the US to bring in ideas that are more globally interesting.

The SPWLA, and our profession in general, are under increasing pressure to provide answers that can be used in today’s completion decisions. Working as a field engineer nearly 40 years ago, the decision-making process was relatively simple. After the well reached TD, wireline logs were run. After the data were acquired, the people on the drilling location, or back at the main office, would make a decision on whether to complete the well or to abandon it. In some cases an advanced petrophysical analysis might be performed to better define a reservoir model. Even in cases where there were good “shows” and the decision to complete the well had already been made, the log data were used refine the completion design.

Today, particularly in areas where horizontal wells are being drilled into unconventional resources, we are seeing a trend of not acquiring any well-log data. This should obviously be a concern for our profession. It seems the industry is not wanting or needing the same answers we have generated for decades and has not yet evolved to the level of using new or existing measurements in different ways. Perhaps it’s time to take a closer look at logging-while-drilling or casedhole formation evaluation as a source of data. It’s also time that we consider the need for reservoir-quality answers as opposed to conventional saturation and porosity information to more efficiently design a completion. The program for our symposium in Houston is designed to encourage new ideas and new applications in this regard.

The “Call for Abstracts” was sent out recently. Hopefully everyone is thinking of ideas for their abstracts. A couple new categories were added to the previous categories in hopes of generating some new ideas. Many people have asked about the possibility of running parallel sessions with good arguments for single and parallel programs. The argument against parallel sessions has generally been that most papers at our symposiums are of interest to all attendees and we do not to have to choose between papers. The argument in favor of parallel sessions has simply been that with the large numbers of abstracts that we usually receive, the SPWLA has had one of the lowest acceptance rates of any professional society and parallel sessions would allow us to accept more papers. The final decision on parallel sessions will be made toward the end of the year.

Hopefully we will have a large number of abstracts to choose from this year. As a society we need to anticipate the needs of the industry both in terms of the data we acquire and the answers we derive from those data.

50th Anniversary of the Archie Equation: Archie Left More Than Just an Equation[1]

FOREWORD

"How can you pass up this once in a lifetime opportunity?" I found myself repeating in my mind after Stephen Prensky, Editor of The Log Analyst, asked me to write this article commemorating the 50th anniversary of Archie's paper. I quickly accepted Stephen's offer, then the realization hit! It had been 25 years since I had first read Archie's paper and hardly a work week had passed since then, that I had not used or relied upon the results of this work or its progeny.

Fig. 1—Reproduction of a portrait of Gus Archie (circa 1966), courtesy Mrs. G.E. Archie

How could I ever capture this overwhelming influence in a single article? What about the background that led up to Archie's publication? I soon faced the prospect of writing an entire biography! Once this scary thought was brought under control, I began picking and choosing those parts of the larger story that I felt best represented Gus Archie's design for petrophysics. It is a simple story about Archie—the gentleman, the engineer, the innovator—and how his quiet, proactive vision set the stage for modern-day concepts in reservoir characterization; no doubt we shall depend upon these concepts in the future as well. And this is Archie's legacy—the principle of interdisciplinary synergism as applied to reservoir characterization.

BACKGROUND

We begin this story in 1930, with Gustave Erdman Archie as a senior at the University of Wisconsin at Madison. Gus had been an enthusiastic student of electrical engineering and would soon graduate with a BS degree. But fate had played a cruel trick on the United States' economy, and the 1930 graduating class watched in horror as the graduates of the 1929 class were laid off from their newly acquired jobs. There would be few, if any, jobs in electrical engineering in June 1930. But Archie had a parachute: his father operated a small quarry in Oconomowoc, Wisconsin, so Archie planned to augment his field of study to include mining engineering in order to acquire the skills needed to work in the family business. The prospect of working for his father was not all that bad, as Gus would later acknowledge; his father was responsible for kindling his interest in science and engineering (R.M. Sneider, personal communication, 1992). Gus earned a BS degree in mining engineering in 1931, but he had become intrigued with mining engineering, and in particular, geology and petrography. Thus, he stayed on to earn a combined MS degree in mining engineering and geology in 1933.

After working with his father for a year, Gus joined Shell Petroleum Corporation in 1934, in Greenwich, Kansas, as an exploitation engineer (Taylor, 1990). One of the professors in the mining engineering department who may have influenced Gus to consider employment by Shell was Dr. Edwin Roy Shorey (E.R. Shorey, Jr., personal communication, 1992).

Gus was assigned to a routine Shell training program, which involved well sitting. There he obtained first-hand experience examining cuttings and cores (electric coring, as Schlumberger wireline electric logs were then referred to, was not readily available in Kansas, having been reintroduced to the US in June 1932). From these early training assignments, Gus learned to appreciate how difficult it was to determine formation porosity and permeability when cuttings were the only source of data. It was in this setting that Archie began to formulate a methodology to permit a schooled observer to determine qualitatively the porosity and permeability from cuttings at the wellsite. Here Archie's electrical engineering and geology background came into play as he recognized the need for downhole measurements of electrical resistivity and acoustic velocity to aid in quantifying reservoir properties (R.M. Sneider, personal communication, 1992).

From the summer of 1932 through the summer of 1938, Shell had been experimenting with Schlumberger electric logs in California, Texas, and Louisiana and felt that quantitative information could be gained from these logs. Shell's Texas-Gulf area production manager, D.B. Collins. knew of Archie's educational background and penchant for formation evaluation, so in the summer of 1938, he had Archie assigned to him in the Texas-Gulf area office in Houston, Texas, and charged him with the task of understanding electric-log responses.

Archie undertook a systematic investigation of every existing Shell Texas-Gulf area electric log together with its companion core analysis, mud log, and test data, and continued to study wells as they were drilled over the next two years. During this time, Gus had numerous discussions with the Schlumberger staff to review the physics of the measurements being offered. Gus also read extensively through the existing literature in petroleum, physics and chemical journals. All this work resulted in four definitive, internal Shell reports, which laid down the fundamental petrophysical relationships later published in his now famous article, "The Electrical Resistivity Log as an Aid in

[1]Originally published in the May–June 1992 issue of The Log Analyst as an invited paper celebrating "50 Years of Archie".
The article has been modified slightly to correct errors in the original manuscript, to clarify some points, and for easier reading.
The article was last updated August 17, 2018, by David Patrick Murphy and E.C. Thomas. Many thanks to David Patrick Murphy for his expertise and help.

Determining Some Reservoir Characteristics" (Archie, 1942). These four internal Shell reports are:

- Archie, G.E., and McCurdy, R.C., 1939, Schlumberger electric logging in the Gulf Coast, June 6.
- Archie, G.E., 1939, The Problem of Using Schlumberger Logging for a Quantitative Study of Sands in the Gulf Coast, June 26.
- Archie, G.E., 1940, Progress Report on Electric Logging in the Gulf Coast Area, June 1939 to March 1940, May 1.
- Archie, G.E., 1941, Analysis of Electric Resistivities of the San Andres Limestone in the Wasson Pool, Texas, January 21.

Gus was also able to draw upon Shell's work in California, published internally by R.C. McCurdy, Schlumberger Progress, September 15, 1937.

I hope that these four reports will become available for public scholars to peruse and appreciate, they clearly show the depth of understanding that Archie had of the phenomena, not only for clean sands, but for shaly sands and limestones as well. Please allow me to quote from the third reference above:

- "Control of well conditions and the cooperation of Schlumberger make it possible to estimate the true resistivity of formations in place underground."
- "The important difference in the sands is due to the variation in the amount of very fine material (less than 200 mesh) or lime contained between the larger sand grains."
- "It will be seen that as the pores of a clean sand become filled with clay or lime particles, the resistivity increases. The increase due to shale will not be large for the resistivity cannot exceed that of a pure shale."
- "The change in resistivity is smaller in clayey sands than in other sands, for clay particles tend to hold water in place. For this reason a clayey sand can contain considerable connate water and produce clean oil."
- "Even though the porosity and permeability of an uncemented (unconsolidated) sand are greatly reduced by clay or fine sand, the electric resistivity will not be greatly increased for the electric current can still go around each individual grain."

Because these quotes have not previously been public knowledge, it is understandable that an earlier author may have misinterpreted Archie's understanding of the problem, i.e., "In 1942, however, conductive minerals and shale were not on Archie's mind" (Edmundson, 1988a). In fact, in 1942 Archie demonstrated a fair understanding of the clean-sand problem and recognized the difficulties in interpreting electric logs in clayey rocks. He later sponsored and directed research to unlock the underlying principles of the resistivity response in shaly sands (Scala, 1989); but this is getting ahead of the story.

THE DEVELOPMENT OF PETROPHYSICS

Archie's systematic study of electric-log responses was but one facet of the multidimensional approach he was undertaking. Gus had the services of Shell's Production Laboratory, under the supervision of H.S. Rockwood and M.A Westbrook; their careful measurements provided Archie the data with which to attack the underlying principles controlling the borehole logging measurements and production performance. Archie's geological and petrographic training led him to realize that it was the fundamental rock-textural parameters that governed the pore structure, which in turn governed the flow characteristics and wireline-log responses. He recognized the true heterogeneity of rocks, particularly on the reservoir scale, and advocated the development of statistical methods as a way to correlate important parameters, such as permeability and formation resistivity factor. His work culminated in the publication of his second public paper, "Electrical Resistivity an Aid in Core-Analysis Interpretation" (Archie, 1947).

One must remember that in the World War II era, the science and logging tools we now know and take for granted did not yet exist. Neutron logs had just been introduced (1941), were in short supply, and little was known about their interpretation (Brons, 1940); the induction log would not be introduced until 1947, the Microlog in 1948, the Microlaterolog in 1951, and the acoustic log in 1954. Thus, all Archie had to work with were the electric logs and a few gamma-ray logs. Porosity and permeability values could only be obtained from core measurements, but coring was costly and risky. Often, the rocks with the highest porosity were the most fragile and could not survive the coring and core-handling methods in use at that time.

Thus, Archie's work was aimed at solving one of the most serious problems of the early 1940's, that of obtaining porosity, permeability and hydrocarbon saturation from electric-log responses correlated and calibrated to core measurements. Even though Gus used statistical approaches to obtain his relationships, he did appreciate the need to understand the fundamental physics of the electric-log measurements. Shortly after his second paper was published, Gus put his ideas to the test.

The setting was western Oklahoma, near Elk City, in the summer of 1947. Shell was drilling a deep test targeted to the Springer Sands at 12,000 ft. The well, Walter No. 1, drilled quickly with no florescence shows in the cuttings, and was logged (electric log) without incident. Protective pipe was set across the Granite Wash zone and the well was deepened to the Springer sands where extensive drillstem tests found no producible hydrocarbons. The Tulsa office management wired the Houston office for permission to plug and abandon the

wildcat, but met resistance from the Vice President, R.W. Bond.

During the time the Tulsa office had been testing the deep zones, Archie had been analyzing the electric logs for the well. Gus plotted the resistivity versus the SP and found a consistent trend, except for one zone, the Granite Wash. Gus made the assumption of constant water salinity and m factor across the logged intervals and reasoned that the anomaly was due to hydrocarbons. No other explanation fit the good SP response in the moderately resistive interval.

Gus was able to convince Reid Bond not to abandon the well without a test of the Granite Wash. The Tulsa staff resisted another test since the zone was drilled without fluorescence in the cuttings. Archie argued that a light hydrocarbon may not have noticeable fluorescence, and since the zone was already behind pipe, it would be a very inexpensive undertaking. On the strength of Archie's recommendation, Reid Bond instructed the Tulsa office to test the Granite Wash (P.E. Jensen and S.M. Paine, personal communications). The zone was about 1,000-ft thick, but they perforated only a few holes scattered over several hundred feet. Archie was at the wellsite for the test and a brisk Oklahoma wind blew his hat into the mud pit just as the well flowed (R.M. Sneider, personal communication, 1992). The test flowed 1,500 barrels of condensate and 30 MMCF gas. Archie was right, but he lost his hat; a small price to pay for discovering the 110-million BOE Elk City Field, which later supported a 20-rig drilling program (E.R. Shorey, Jr., personal communication, 1992).

This success brought instant fame for Archie within Shell, but this was not without drawbacks. The Vice President now insisted that Archie interpret the logs on every wildcat east of the Rockies before he would concur with plans to plug and abandon (R.M. Sneider, personal communication, 1992).

Archie was then given the opportunity to select and train promising young exploitation engineers in his log-interpretation methods. Later he was instrumental in establishing a separate training department to teach these skills to all Shell engineers. Housed in the same Houston office was the fledgling E&P research group, and in 1946 a new hire named W.R. (Bob) Purcell joined the staff to work with M. King Hubbert. Hubbert suggested that Bob needed Archie's training, so Purcell was taken into Gus' group. After logging wells at Black Bayou field, Bob went to the core-analysis group under M.A. (Westy) Westbrook. Here Purcell got the approval for building his mercury injection capillary pressure apparatus which led to his famous 1949 paper (Purcell, 1949). This was just an example of the Archie style of training and management. He supported Bob in all his efforts, even when Bob's paper was criticized at the AIME meeting. Archie did this because he could see the importance of Bob's mercury capillary pressure work in characterizing pore distributions. Gus quickly adopted this new core-analysis technique into his methodology of interpreting logs. In July of 1947, the E&P Research group moved into their new laboratory on Bellaire Boulevard, but this did not end Archie and Purcell's interaction.

During the post-war years Archie was not alone in developing theories about the interrelations of porosity, permeability, saturation and resistivity. Many other oil companies were doing parallel research and had come to similar conclusions. The literature of the time was alive with controversy about the exact form of the equations, and the history of these developments has been beautifully captured in a series of articles in The Technical Review, by Henry Edmundson (Edmundson, 1988a, b). My only addition to this well-crafted story refers to the personal relationship of M.R.J. Wyllie and Gus Archie. While they may have published conflicting proposals, Gus respected the work that Wyllie had done and the two of them visited often for scientific discussions (S.M. Paine, personal communication, 1992).

Gus now drew together all of the pieces of the process he had been developing and set the foundation for a new branch of petroleum technology. In September 1949, Gus presented before the Houston Geological Society, and later published in the Bulletin of the American Association of Petroleum Geologists, the paper which forever married geology and physics: "Introduction to Petrophysics of Reservoir Rocks" (Archie, 1950). In this seminal work, he introduced the term petrophysics to express the physics of rocks. The word itself had been coined earlier in discussions about the subject with Gus' counterpart with the Royal Dutch Shell Group, J.H.M.A. Thomeer, during a quiet evening in The Hague (Abbott, 1986; J.H.M. Thomeer [his son, Bert, also a Shell petrophysicist], personal communication, 1990).

But Archie wanted to emphasize the concept that through understanding the geological parameters of a rock, one could explain all of the resulting physical properties of a given rock type. Gus showed that formations that had been deposited under similar conditions and had undergone similar processes of later weathering, cementation or resolution would have similar physical properties. He demonstrated that these processes would lead to rock types with similar pore-size distributions, which in turn governed their porosity, permeability, water saturation and capillary-pressure behavior. One can see in this paper that one key step in the process was using Purcell's mercury capillary pressure tests to characterize the rock types. Gus then showed that for a given rock type one could use electrical resistivity, spontaneous potential, and neutron response to obtain porosity, permeability and fluid saturation through indirect correlation with numerous core measurements to establish trends.

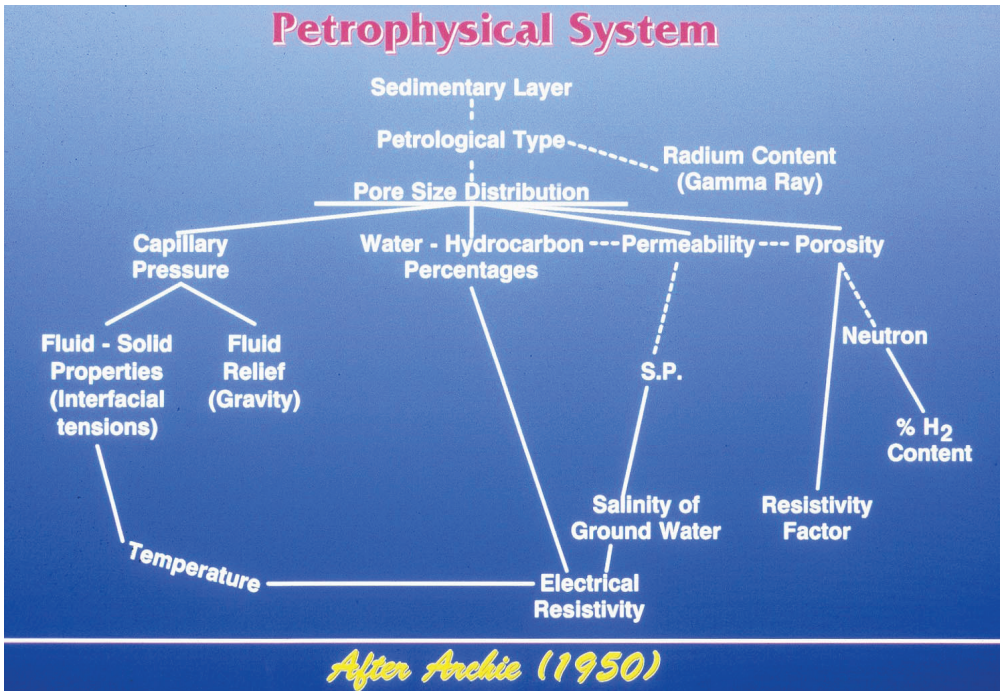


Fig. 2—Archie's diagram of his Petrophysical System.

He diagrammed in his 1950 work what he called the Petrophysical System (Fig. 2). It tied together all the known logging-tool responses to the desired parameters of porosity, permeability and water saturation through the controlling physical properties of capillary pressure, interfacial tensions, temperature, gravity, salinity, and hydrogen content. It is still valid; all we have to do is include the current suite of logging tools and their responses, add grain density and you have a modern recipe for log analysis. When Archie discussed his "System," he pointed out that it revolved mainly around the pore-size distribution, but that a pore-size distribution did not necessarily define the type of rock by itself, because several rock types may have essentially the same pore-size distribution. This single point is the essence of modern formation evaluation; one must never expect all rocks from the same area or same geological age to have the same petrophysical parameters, because it is neither area nor age that governs physical properties; it is the pore-size distribution that matters, e.g., if a Miocene sand from south Louisiana and a Jurassic sand from the North Sea have the same pore-size distribution, one could expect similar porosity and permeability, while two east Texas Cotton Valley sands only 10-ft apart in the wellbore may have vastly different values of porosity and permeability.

But Archie also realized that the mineral composition of the rock should not be neglected in the study of rock interrelationships. He recognized that the type and amount of clay minerals present would play an important role. He also mentioned that logging of drill cuttings played an important part of his Petrophysical System. He expected the well-sitter to provide a lithologic description as well as a pore-size distribution. How he expected this to be done was published later (Archie, 1952).

AN ADVOCATE FOR PRODUCTION GEOLOGY

Archie's training in geology and petrography always provided him the ability to see formation evaluation from a different perspective than the average petroleum engineer. His early Shell training doing well-sitting and cuttings-logging in Kansas led him to appreciate the difficulties in finding the thin pay zones imbedded in thick nonporous intervals. He also came to appreciate how difficult it was to correctly predict drillsite locations for appraisal wells following a wildcat discovery. Gus believed that some of the exploration department geologists should be made available to the production department to aid the exploitation engineers in their jobs. Archie felt he needed to work side-by-side with someone who could help him describe the rocks and develop methods for examining cuttings in the field. In turn, Archie felt he could aid the geologist in understanding the connectivity of formations from well to well, based on log responses, and so aid in predicting appraisal-well locations. Archie also felt log responses could be related to depositional environments and he vigorously supported research programs in this area. Archie believed that engineers should specialize in order to maximize understanding in a particular area, but work together in teams to solve exploitation problems.

Archie's dream was to develop a system to estimate porosity and permeability from cuttings. Methods for describing sandstone cuttings depended upon understanding grain size, sorting, shaliness, cementation, and degree of consolidation. Correlations of these parameters with porosity and permeability

proved to be useful. However, these methods were not fruitful for many types of carbonate rocks. A standard description that provided color, fossils, bedding, etc. provided no petrophysical information. What Archie needed was a completely different approach and so he developed his method for typing carbonate rocks based on pore types.

In April 1951, Archie presented the paper "Classification of Carbonate Reservoir Rocks and Petrophysical Considerations," to the St. Louis meeting of AAPG. The paper was later published (Archie, 1952) and in it he gave full credit to the contributions of geologists who had aided him in developing his ideas namely: C.G. Cooper, R.C. Spivey, and Doc Wilhelm. The idea of classifying carbonate rocks in such a manner to convey as much as possible about the essential pore characteristics of a reservoir was revolutionary, and met with much skepticism in the geological community. It proved to be a valuable technical advantage for Shell. Archie showed that by classifying carbonate rocks based on the texture of the matrix and the character of the visible pore structure, one could easily separate rocks into permeability ranges (qualitatively) and semiquantitatively predict porosity. "I didn't need the logs when I used Archie's classification system. All I had to do was stay awake, capture representative ditch cuttings, examine them carefully for shows, and use Gus's method and I never missed a pay zone. Hell, the electric logs were usually so bad in the dense carbonate reefs that I felt better using the Archie method anyway" (H.J. Hill, personal communication, 1992).

THE FOUNDATIONS OF RESEARCH AND TRAINING

In 1951, Shell established a Technical Services Division in the Houston office under the direction of Joe Chalmers. There, specialists like Archie in petrophysics, George Dickenson and Doc Wilhelm in geology, and Tony van Everdingen in reservoir engineering worked as a team to solve subsurface evaluation problems for all of the operating divisions. This group also trained the most promising of Shell's engineers and geologists to use the newest technological advances perfected at Shell E&P Research labs. Archie was a strong advocate of specialized training and he spent considerable time and effort to develop training manuals for petrophysical engineering; some of his training documents are still used in Shell's E&P training center! [Note: as of the writing of this article in1992, but not necessarily today, 2018].

The Technical Services consulting group was so successful that Shell management felt they could benefit from being closer to the E&P Research staff and thereby enhance rapid technology transfer. Thus, when the new research building was completed on July 16, 1956, the Technical Services Division moved to its new home in the E&P Research community. Archie began in earnest to build a group of highly talented scientists who could be problem solvers (see Fig. 3). Let me quote one of the individuals hired at this time, Professor Ray Murray, University of Montana: "In hiring, he had an extremely broad vision. He almost never hired someone who was 'trained for the job.' He hired people who were broadly trained and who he perceived could he directed toward those issues that he saw as important to the future. His guidance and direction was extremely subtle. Everyone had the feeling that they were working on or doing what they wanted to do. However, when you looked at the entire organization, everyone was moving in the same direction as part of Gus' larger vision" (R.C. Murray, personal communication, 1992)."

Technical Services flourished in this environment and in 1958 became part of Shell Development Company with Gus Archie named Manager of Exploitation Engineering Research. His research group contained three sections: Reservoir Engineering, Petrophysical Engineering and Production Geology. From this position Archie was able to recruit and direct research that had far reaching and long-lasting effects: Harold Hill and John Milburn's paper on SP and resistivity of shaly sands (Hill and Milburn, 1956); Harold Hill and A. Anderson's paper on streaming potential and SP (Hill and Anderson, 1959), Monroe Waxman and Lambert Smits' paper on resistivity behavior of shaly sands (Waxman and Smits, 1968); and George Klein, Harold Hill and O.J. Shirley's paper on bound water in shaly sands (Hill et al., 1979); just to name a few. Of course, most of the research done in this group was held confidential, applied by oil company engineers, then discarded as newer research led to better methodologies.

One of the classic unpublished field experiments performed by this group was in cooperation with Schlumberger. Archie and Schlumberger disagreed on the magnitude of the mudcake-filtrate effect on the SP response. Shell Oil furnished a suitable test well near Scott's Bluff, Nebraska, where a thick Dakota sand was penetrated. Mike Gondoin of Schlumberger, Monroe Waxman, and Harold Hill of Shell Development spent a week logging the zone with different surface pressures and different salinity mud filtrate. The results confirmed Shell's position. Harold phoned Archie the good news, then proceeded to throw a party for the Shell and Schlumberger participants. Harold turned in a bill for $180, which Archie approved perfunctorily. Only later during a dinner with Gus and a production vice president, Ed Christensen, did Archie remark that the living costs in Scott's Bluff were "high" and Ed said, "Real high" (H.J. Hill, personal communication, 1992; M.H. Waxman, personal communicaton, 1990).

An Archie innovation to foster technology transfer between the research group and the engineers in the field was to cross-transfer PhD scientists from the lab out into the oil company and select technically strong engineers from the field to come into the research lab for a one-year assignment. This provided new perspectives for each individual and provided personal contacts for future technical problem solving. This process continues today (W.R. Purcell, personal communication, 1992).

Fig. 3—Diagram of Archie's Organization for Effective Research in Shell Oil Co.

Fig. 4—Photograph of Archie, some of his group and managers taken on a 1953 field trip to Shell's Williston Basin fields. From left, Tom Barnes, Loy Charter, Sam Paine, Gus Archie, and Charles Rabe.

Gus managed this research group until 1966, when he was made an assistant to the Vice-President of Research. His last publication was written at this time. Gus was invited to contribute to the National Petroleum Council document, Impact of New Technology on the U.S. Petroleum Industry 1946–1965, (Archie, 1967a, b, c). It is understandable that Gus was asked to write the section on Formation Evaluation, but more remarkable, he was also asked to write the section on Production Geology, and the section on Properties of Reservoir Systems. While these sections were designed to be reviews of the technology, Gus was able to weave into the story his vision for both production geology and petrophysics. Much of what he recorded was, or later became, Shell methodology.

Archie (1967a) laid out the definition of the role for a production geologist: "The interpretation of the geologic history and the prediction of the limits and the distribution of the internal rock fabric of an accumulation is called production geology." He expected the production geologist to locate appraisal wells "in such a way as to obtain the greatest amount of geological information for predicting extensions and limits of the reservoir and to achieve the most efficient production." The production geologist was to understand the internal fabric and heterogeneities of the reservoir sufficiently well to aid the reservoir engineer in his design of more productive secondary and tertiary recovery operations.

Gus then defined the role of the petrophysical engineer (Archie, 1967b): "The process of using information obtained from a borehole to determine the physical and chemical properties of the rocks and their fluid content, especially hydrocarbons, is known as formation evaluation. The complexity and importance of formation evaluation have led to the establishment of a new technical position in many companies—the formation analyst or petrophysical engineer, who brings into play a knowledge of physics, chemistry, geology, and engineering in developing and using physiochemical and petrological relationships." Gus said that the goal of the petrophysical engineer was the accurate determination of reservoir thickness, porosity, permeability, and

oil saturation, at a reasonable cost. He advocated use of all the available data: cores and core analysis, mud logs and cuttings analysis, formation tests, and wireline logs. We still recommend this methodology. The last section, on properties of reservoir systems (Archie, 1967c), was perhaps the most profound. Here he explained how crucial it was to know the properties and performance of both the rock and its fluids at all scales in the reservoir, and how each level must be integrated into the overall performance and reserve prediction for the reservoir. He chose three scales: "(1) the reservoir as a whole, (2) a unit cube of the reservoir, and (3) a single pore." He discussed how important it was to understand the fluid systems, the pore structure of reservoir rocks, the rock-fluid system and the reservoir rock system. His final recommendation was: "It is important to continue the basic research of microscopic phase distribution of hydrocarbon-water systems in porous media in relation to mineralogy, wettability, diffusion, and oil trapping, particularly from a dynamic point of view." These words predicted the course of research in most every oil company and university petroleum-engineering lab for the next 20 years, but Archie only lived a few more years and did not get to see his predictions come to pass.

THE TWO-FOLD LEGACY

Archie's work lives on in two ways; through the ideas and equations he published in the open literature, and through the engineers and scientists he hired and/or trained in Shell. In the latter case these engineers have propagated Archie's ideas and methods to this very day; we still hear the words "Have you looked at the rocks?" every time we evaluate a wireline log.

Archie had an uncanny ability in being able to sense an individual's capability for innovation and intuition. He carefully chose the engineers whom he made into petrophysical engineers and many rose to prominent positions within and without Shell. These include Phil Jensen, Sam Paine, Charlie Blackburn, Frank Richardson, Harold Hill, Bob Sneider, Ray Murray, Dick Pickett, George Stegemeier, Bert Thomeer, Jim Jorden, and Denny Loren, just to name a few (see Fig. 5 for a partial list). In many ways Gus was like a university professor who attracted good graduate students who would go on to be as famous, or more famous, than their mentor.

But the other part of the legacy is just as important; almost without exception, Archie's ideas are either being practiced routinely or they're being further developed by the petroleum industry (Abbott, 1986; Paine, 1988). His concept of holistic formation evaluation, rather than just log analysis, is fundamental and now recognized as a separate technological entity by the Society of Petroleum Engineers. His concept of multiple measurements and trend analysis, as opposed to mathematical rigor, has proved successful in every producing basin, and even today, these statistical methods are yielding to stochastic methods running on powerful computers. You can't argue against his dictum of using "all the available data to arrive at the solution which best fits these responses."

EPILOGUE

After interviewing more than a dozen of Archie's coworkers and trainees, and reading over 40 of his technical reports, a clear picture of Gus' personality emerged. He was a quiet and modest gentleman, easy to work for, genuinely concerned about people and their cares, tolerant of other's ideas, he let people make their own mistakes, and he fostered teamwork. When asked what Gus' hobby was, Bill Hurst replied, "His family" (W. Hurst, personal communication, 1992). Archie objected when others called his equations, "Archie's Laws." He steadfastly refused to make sweeping claims for his "trends," and was very careful to stay within the bounds of his empirical correlations. His degree of modesty can best be explained by relating that his departmental secretary from 1958–1966 did not know of his international fame until she read his obituary in 1978. Pomp and flair were not in his repertoire; integrity, empathy, intuition, credibility, determination, and perception most certainly were. He deserves every award and accolade given him and more.

And it is most fitting that the Archie Conference, named in his honor, focuses on interdisciplinary studies of geology, geophysics and petrophysics (Sneider, 1990). Gus had the knack of identifying important problems, bringing together the right people to solve the problems, then backing away and letting the scientists and engineers work to find a solution. Gus's approach to managing people set an atmosphere that encouraged cooperation and exchange among the various disciplines. The concept of teamwork may be his greatest legacy. Only those of the future will know.

NOTE ADDED August 17, 2018: Some readers (over the years) have asked more about Archie and shaly sands. I paraphrase a quote from Monroe Waxman, "Our shaly sand research group met regularly with Gus to discuss ongoing research in shaly sands. Archie was always one step ahead of us with ideas for additional research that was invariably right on. His last directive to me for my new shaly sand equation in preparation was 'no new parameters unless they can be independently determined by laboratory measurements, and please do not add more than one, to keep it simple for evaluation in the field.'" So my answer is yes, from my interviews in 1992 it was clear to me that Archie had an in-depth understanding of the electrical behavior of shaly sands.

Other readers asked whether Archie would have been able to explain self-sourced tight reservoirs, i.e. today's unconventional plays. My answer is that I am not clairvoyant nor could I probe Archie's mind in the past to produce any answer worth printing today.

Fig. 5—A partial list of those trained by Archie working in Shell Oil Co. in 1992.

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There were so many Shell and ex-Shell individuals who helped me gather information for this article that I will never be able to thank them all. However, a few went to such extraordinary lengths to help me that I must give them personal thanks. First the staff the BRC Library were tireless; Carmen Miller and especially, Aphrodite Mamolides, whose "thrill of the hunt" led her to herculean journeys through the annals of Shell literature; likewise, with the staff in BRC Technical Files, especially Selestine Weams, who found copies of every technical article written by Gus Archie; also to Miriam Barber who copied ancient personal reports written with uncopiable light-blue carbon paper. Next I thank those individuals who allowed me to probe their personal memories of Archie, without which this commemorative article would have been only a copy of past accolades; in alphabetical order: Powell Dennie, Harold Hill, William Hurst, Phil Jensen, Jim Jorden, Charlie Matthews, Ray Murray, Sam Paine, Bob Purcell, Bob Shorey, J. T. Smith, Bob Sneider, George Stegemeier, Bert Thomeer, Natalie Waggoner, Monroe Waxman, and Paul and Margie Wichmann. Of course, I appreciate the editorial help of Sam Paine, George Stegemeier, Bert Thomeer, and Jim Jorden who unselfishly gave of their time to improve the text. Lastly I thank the management of Shell Oil Company for their support and permission to publish this article.

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ABOUT THE AUTHOR

E.C. Thomas is a consulting petrophysicist and owner of Bayou Petrophysics and provides technical training in shaly sand analyses and all other areas of petrophysics for Petroskills. E.C.'s professional career interests and publications have spanned the entire field of formation evaluation/ reservoir characterization, i.e., petrophysics. In 1992, he wrote a biographical sketch of Gus Archie for The Log Analyst to commemorate the 50th anniversary of the publication of the Archie Equation.

E.C. retired from Shell E&P Technology Company as a Petrophysical Advisor where he actively pursued research and field evaluation topics in the area of petrophysics for over 32 years. He also authored and taught basic, intermediate and advanced courses in petrophysics for more than seven years at Shell's Training Center. E.C. 's academic background includes a BS in Chemistry from LSU, a PhD in Physical Chemistry from Stanford University, and a year of postdoctoral research in Physical Chemistry at Princeton University.

E.C. has served SPWLA and SPE in many capacities, including SPE Distinguished Lecturer and chairman of the 1998 Archie Conference. Professional recognitions have included invitations to serve as keynote speaker at several SPE and SPWLA regional and topical conferences, and at the 2005 SPWLA Annual Symposium. In 2000, E.C. received the SPWLA Distinguished Technical Achievement Award; and in 2004, the SPWLA Gold Medal Award for Technical Achievement. E.C. served as a Petrophysical Consultant to the President's Commission investigating the BP-Deepwater Horizon blowout and resulting oil spill. E.C. currently serves as a technical reviewer for Petrophysics and SPE Reservoir Evaluation & Engineering.

Petrophysical Software: Interface Design from the User's Perspective

Dan Krygowski
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Computer systems (software and hardware) are ubiquitous in our environment and growing more so; from software that starts our automobiles to driving them for us, from smart phones on which we occasionally make telephone calls to devices which always know where we are (and apparently share that information with others). In the world of petrophysics, in the length of my career (yes, a long one so far…), we have gone from computers doing the same arithmetic as we did, but much faster, to doing mathematics more complex than we can do in a reasonable amount of time, if even at all.

The presence of computing power goes far beyond just quicker and more complex interpretive workflows. It includes the acquisition of data and the preprocessing of that data, which was often initially done by mechanical or electrical systems but is now done with complex mathematical methods. Those methods not only acquire the original signals, but also process those original signals for the environment in which they were acquired. The "raw" data delivered to us today are far more processed than the data that were delivered prior to the introduction of computer-based acquisition systems in the late 1970s and early 1980s.

We who are clients of data-acquisition companies have little to no input to the inner workings of that acquisition software, with our only input to the software being binary; YES, I like the results of your acquisition and processing and will keep using you, or NO, I don't like your results and will go elsewhere for the data.

We can consider petrophysical software in two very broad groups; one group is the software that is developed by a specific acquisition company for its own acquisition engineers and interpretation specialists but is available for purchase by others. The other group is more generic; that is, the software is built to use any company's acquired data with more broad interpretive methods (applicable to all similar data from any source). The line between the two groups has blurred in recent years, with acquisition companies buying existing generic programs, and modifying them to meet their specific needs, while sometimes discarding existing systems in the process. My sense is, however, that if one picks one of the latter systems instead of one of the former systems, the options for user input for change are greater.

So why would a user be interested in software interface design?

Some reasons might be:

- The interface might be difficult to understand or use;
- It may be missing critical information (data entry and/or references for the functionality);
- It may be missing desired options, like the choice of a specific algorithm;
- Or any of several other reasons that come to your own thoughts…

Many of us have learned through experience that Subject Matter Experts and software developers would usually rather add new functionality than go back and fix or improve interfaces, so it might be helpful in getting their attention for interface changes in a more positive way than saying, "Your software really sucks…"

One method that I found useful in interface design (after being told as an SME on a software development team that "my software sucked") was to apply Lean Manufacturing Principles, from the Mid-America Manufacturing Technology Center. The principles state: "Have the right tools in the right place at the right time, clean and ready to use. And strive for the continuous improvement of those tools."

Hmmm… So how does this work? I don't see a hammer or a screwdriver on the user interface on my computer screen. I just see text boxes, buttons, and dropdown menus.

BUT WAIT—Each of those components on the interface can be considered a "tool" because it is helping you accomplish a task, just like a hammer is better at driving a nail than your fist.

So, each component is a tool:

- Is each tool the "right tool" for the task it is expected to perform? Does it help you accomplish the task at hand?
- Is it at the "right place" on the interface? Is it in the right location, the right size, and is it recognized by you for what it is supposed to do?
- Is it presented at the "right time"? Is it in the proper place in the workflow that you are using?

"Clean and ready to use"?

- Are the buttons, sliders, and checkboxes properly chosen, sized and arranged to fit the workflow?
- Are text boxes sufficiently sized (not too big or too small)?
- Are appropriate or common settings and default values presented?

What about the "strive for continuous improvement of those tools"? Now it's time to consider the user's interactions with the group of tools, such as those used in a workflow. Have an ongoing process to modify the tools to

- Remove unnecessary actions;
- Reduce necessary actions (to increase efficiency);
- Improve actions that add value (to improve efficiency, cost-effectiveness, and speed).

"So, Dan" you might ask, "Do you have experience with this method?"

And my resounding answer is, "YES." Over a decade ago, when I was the SME for Landmark's PetroWorks petrophysical software, several plain-spoken clients ganged up on me and told me what they thought of our software. Those comments (and the threat to go elsewhere for software) resulted in the application of Lean Manufacturing Principles to the Crossplot application in PetroWorks.

Working with the clients, we went from a workflow that was a series of separate windows, each asking for one value (and often the wrong tool in the wrong place at the wrong time) to a single tabbed interface, with each tab set up to be moved through from left to right or top to bottom.

As examples of the efficiency gained:

- Creating a basic 2D (x-y) crossplot:
  - Old interface: 3 windows 11 button clicks 6 text entries
  - New interface: 2 windows 8 button clicks 0 text entries
- Creating the above crossplot with histograms, log tracks, and one additional curve in each log track:
  - Old interface: 7 windows 37 button clicks 30 text entries
  - New interface: 3 windows 23 button clicks 0 text entries

And once templates were constructed for each graphic in the second case above, the number of actions (windows, button clicks, and text entries) dropped from 26 to 6. Refer to The Discovery Group webpage for details of the method and this example: http://www.discovery-group.com/pdfs/2018_LeanMfgInterface.pdf

The resulting interface was much more pleasant and efficient to use (based on comments from the users), was easier for current and new users to learn, and as importantly, required much less maintenance than the old version. Our success with crossplot got the development team thinking that occasional redesigns of specific apps in the software package could be less intensive and time-consuming than trying to add some additional functionality to an existing product.

So, I hope that this column has at least indicated that, as a user, you can (and should) have a lot of say in improving the petrophysical software interface with which you must work. Remember that you don't have to do this alone. To be more effective, get together with other clients and the software provider, and discuss, cajole, demand, and threaten the provider until the appropriate changes are made. (Use of the phrase "carpal tunnel syndrome" can also be effective…)

Underlying the topic of this column is the thought that while interface design and optimization aren't the "cool" things to work on, or maybe even "necessary," improving the interfaces in software products will improve work efficiencies in many ways; from making the software easier to learn and use, to decreasing the time spent on an interpretive workflow, and probably to less errors made in that workflow. And if the software provider is willing to look beyond the next release, there are significant benefits for them as well.

Chris Skelt

My life in the oil industry started in Paris, in September 1977, with a ticket to Maracaibo to attend the Schlumberger Field Engineers' Training School in Las Morochas, Venezuela. Having escaped a desk job in London I couldn't have been happier with the challenges and irregular hours of field operations, only questioning them after the second consecutive sunrise. When the sun comes up on the third day on duty, you're on autopilot and there's no questioning. I'm privileged to have had this entry to the business and experiences like the heli-rig site in Colombia captured in the photo during a break in the seasonal rains. Not the best logs I ever produced, but nor were conditions conducive to perfection. This was where to read One Hundred Years of Solitude on location and a Schlumberger ball cap bought a hair-raising helicopter ride across the swamps with a pilot who delighted in harassing monkeys, caiman and capybaras.

From the late 1970s, computerized acquisition and interpretation systems began to replace the analog panels and galvanometer-based camera we were trained to operate. These systems allowed taking the computer-based log analysis that started in the early 1970s in a handful of log interpretation centers in big cities, to isolated wellsites where a young engineer working with an experienced oil company petrophysicist could produce a credible shaly sand analysis, supported by computations of formation dip and permeability estimates and fluid samples from wireline formation tests—reliable information for the decision to run casing and test, or to abandon the well.

Porosity, lithology and saturation were initially computed using resistivity (induction or laterolog and microresistivity), gamma-ray, density and neutron logs. Why? Because they were

the first tools that delivered quantitative values with more or less the same vertical resolution, permitting frame-by-frame computations. The first log analysis programs, whether wellsite quicklooks or their more sophisticated log interpretation center relatives, used logic previously used for manual interpretation on a handful of carefully chosen points. Application to thousands of sequential depth frames in moments brought a massive productivity increase and produced a graphical result that was easily understood and communicated. The underlying assumptions, for example that the material present in the "shale" intervals defined the nonclay content of the "shaly sands," were considered axiomatic and, despite our skepticism, there was no persuasive counterevidence.

The 1980s brought simultaneous industry downsizing and intensive innovation with the introduction and consolidation of targeted pressure measurements and fluid sampling, spectral gamma, electromagnetic propagation, array sonic, geochemical and induced spectroscopy measurements, ultrasonic and resistivity borehole images and vertical seismic profiling. Oil-based mud stabilized the borehole and improved log quality, and high-angle and horizontal wells demanded logging-while-drilling and pipe conveyance as alternatives to running wireline. Nuclear magnetic resonance just missed the cutoff, following in the early 1990s.

The plethora of logging tools meant that effective interpretation using all the available data demanded flexibility in the choice of inputs and computed formation components—rocks, minerals and fluids. Schlumberger's GLOBAL program achieved this in 1980 by expecting the user to select input logs and the rocks, minerals and fluids to quantify. When I arrived at Schlumberger's London Log Interpretation Centre in London in 1984, we used GLOBAL to solve the shaly sand problem with triple-combo logs, or to apply more comprehensive logging suites to more complex lithology, mineralogy and fluid problems. If transforming triple-combo logs via a sequence of geometry-based calculations to lithology, porosity and fluids was the first generation of computerized analysis, we were now into the second generation. The principle of analysis by solving a set of simultaneous equations is conceptually simpler than geometric gymnastics on neutron-density crossplots and, although impractical by hand, our mainframe computers worked long hours and never complained. If computers

had predated logging tools, I imagine that solving the user's chosen suite of response equations would have been the "obvious" quantitative compositional analysis method.

Simultaneous improvements in core analysis, and the appreciation that core and log data had complementary strengths and shortcomings, led to more integration, and by the end of the 1980s, the scope of the job had massively increased. For example, a geomechanical analysis of a deviated wellbore could be reconciled with rock mechanics laboratory measurements, core-derived mineralogy and elemental chemistry supported geochemical logs for credible analyses of formations with complex mineralogy, fractures and detailed stratigraphy were interpreted from image logs, and geophysical applications, such as the Gassmann equation for fluid substitution became available to petrophysicists.

The difference between the original cookbook methodologies and solving response equations is sometimes represented as simple lithology versus many minerals. This misses the point. The hardwired first-generation models required the user to either accept what we now know is an oversimplified model of the subsurface, or to figure out creative ways to work around the limitations of naïve and incorrect assumptions—an unproductive exercise—whereas a second-generation application user defines the model around the fundamental building blocks of the subsurface—rocks, minerals, fluids, texture—for a fit-for-purpose analysis tailored towards the project's needs. In the unusual case that a triple-combo can be transformed into a definitive shaly sand or simple carbonate analysis, the results from first- and second-generation programs should differ only in minor detail.

The Thomas-Stieber (T-S) laminated petrophysical model dates from the 1970s, and like the shaly sand model, invokes what initially appear to be reasonable assumptions. It was intended to be used where the earth is made up of unresolved alternating shale and sand beds. In the sands, the grains have constant inherent porosity modified by one or other of pore filling and granular material; shale is present as discrete laminations, and the three shale types share the same properties. These assumptions make for easy computation but are usually disproved by photomicrographs. The shaly sand model assumes that the logs resolve the beds, while the T-S model assumes the logs see an effective medium. Unfortunately, few reservoirs conform to one or other condition, and beds of intermediate thickness and their boundaries are resolved according to the individual geometric responses of the measurements, leading to ugly computational artifacts. Although the tools of the mid- to late 1980s gave the analyst flexibility in designing models, they treated each depth frame as an isolated entity. Because the measurements have different vertical resolution, frame-by-frame calculations combine different volumes of formation properties, introducing unquantifiable errors in formations where heterogeneity is detected but not fully resolved. This prompted efforts to match the resolution of the lazier logs to that of the more active, typically by forward modeling the tool response for a squared formation profile model, comparing the modeled and recorded logs, and iterating towards a match.

Considering the 1D response along the well axis prompts taking account of anisotropy in its various forms, such as radial property variations caused by fluid invasion and mechanical alteration, and circumferential phenomena such as the effect of gravity on fluid and stress distribution around deviated wells. Tool-resolution matching and enhancement techniques using a combination of forward modeling and inversion has continued to evolve. Since the late 1990s the UT Austin Formation Evaluation Consortium has led the industry in configuring and reconciling increasingly sophisticated static and dynamic near-wellbore models with logging-tool geometric responses with potential to rigorously reconcile data from the scale of CT micro-images to wireline logs and formation tests and potentially well tests, crosswell tomography, VSPs etc.

Commercial-grade software tools are available and practitioners should develop expertise, particularly to address the frequent cases where established methods break down. This approach has already been shown to successfully address formations with beds too thick for laminated models, but too thin to claim that the logs fully resolve the heterogeneity. The industry's ability to harness this "third-generation" technology is maturing, and its ultimate scope and influence on the way we analyze the subsurface will no doubt surprise us. However, taking its origins as the 6FF40 induction forward-modeling tools that I first encountered in 1986, it's a long gestation. It's challenging, but if you want to persuade a review team that you have fully reconciled all the apparent anomalies and discrepancies in the data, this is the most rigorous approach current technology can offer.

There's a lot of buzz in the industry about big data and machine learning and if it is ever successfully applied in a domain recognizable as petrophysics, it would be a fourth-generation methodology. Forecasting how its take up will influence the petrophysicists' role is speculative. Unlike high-profile applications, such as self-driving cars, subsurface characterization applies the laws of physics and the tenets of geology. Totally data-driven algorithms would ignore the science we currently use effectively in our work practices, so there should be consideration of how new algorithms could most effectively complement today's state-of-the-art physics-based practices. And with few exceptions, the properties we are estimating—net thickness, hidden fluid contacts, oil-in-

place, deliverability, subsurface stresses etc.—are conjectural, giving a blurred and inconsistent training picture to the algorithm.

Parameterizing standardized workflows is an accessible application for machine learning. This is not a new idea, as the preprocessor to Schlumberger's VOLAN program did it in the late 1970s. An attractive consequence is that a simple, lowest-common-denominator model could be produced quickly and potentially more consistently than by individuals, freeing them to concentrate on how to overcome the result's shortcomings and better address the needs of the diverse group of stakeholders intending to derive value in many forms from a comprehensive final petrophysical evaluation. Other than the "machine learning" aspects, I illustrated this principle in my paper "Interpreting the Whole Well" presented at the recent SPWLA Annual Symposium.

That concludes a personal view of the development of petrophysical measurements and interpretation applications. I was fortunate to be mentored by many of the great names during my time in Schlumberger and Shell, and to subsequently develop my own ideas at Scott Pickford and LASMO as the sole, or lead practitioner, supported by an active peer group of fellow London Petrophysical Society members. Family reasons brought me to Houston to join UNOCAL at the end of 2001 and I have been with Chevron since their acquisition of UNOCAL in 2005. I spent several years managing a collaborative R&D program at Los Alamos National Laboratory investigating the feasibility of nonlinear acoustics applications for subsurface characterization, and as of 2012, my focus is on improving our effectiveness in using well data to support quantitative estimation of subsurface properties from seismic data.

Petrophysicists are sometimes mischaracterized as "the guys responsible for the porosity, saturation and net thickness numbers that seed the earth model or contribute to the reserves equation." A standard interpretation of a simple reservoir is indeed part of an oil company's day-to-day activities of, but adds little value to the oil or gas already in the ground, is usually accompanied by a bogus assessment of uncertainties, and hopefully will soon the responsibility of an algorithm. It's required because projects need development plans, but rather than repeat shrink-wrapped workflows that may or may not capture the salient properties of the subsurface, the goal should be to avoid being caught out by Mother Nature. Unless yours are the first eyes on the data, adding value means seeing something missed by your predecessors. This could be explaining how the previous interpretation was wrong and reinterpreting wells to impact the prospectivity of an exploration play, or explaining why the field is underperforming or overperforming, rethinking reserves, and proposing a remedial development strategy. Unavailability of software tools, as was the case when thinly bedded low-resistivity pay was first appreciated, should not prevent an alternative interpretation to the computation results as employers derive more value from the petrophysicist's judgment than their ability to run programs.

Leaving aside the rise of unconventional reservoirs, many practitioners remain wedded to first-generation methodology. My contemporaries, taught by the generation that introduced these ideas, appear to be passing this tradition to our young colleagues and expecting them to practice it. Is there any other industry where practitioners use computers to reproduce the chart and slide-rule-driven thinking of their grandparents' generation? Justifications like "if we're still doing it after all those years it must be good" would be defensible if true, but there are many examples where oil- and gas-in-place, or production, have been massively miscalculated—often overestimated, but pessimistic analyses occur also. Every seriously erroneous assessment of the resource is an opportunity to reevaluate, and the following are some examples covering exploration to mature field development. Some were solo, but most happened only because a quorum of like-minded people came together.

The team exploring offshore prospects in Asia was working with third-party interpretations of washed-out offset wells with poor-quality logs interpreted as gas-filled shaly sand sequences. A closer look at the logs and drilling records prompted reinterpretation as a sedimentary evaporite basin. Gassy sands became thinly bedded halite! This was disappointing but subsequently verified.

An optimistic assessment of gas in an onshore field in Asia resulted in oversized facilities, disappointing production and concern that the field was nearing the end of its productive life. A fieldwide multimineral analysis of wells reconciled production with well data and identified additional pay in numerous thin washed-out intervals, increasing booked reserves and prompting a successful infill drilling program.

Numerous dry exploration wells have been drilled where the team was misled by apparent hydrocarbon indications on the seismic data, often prompting a view that the laws of geophysics had been locally suspended. Petrophysicists have tools to explain anomalies by the attenuated tool response to thin oil- and gas-filled beds, immobile low-saturation gas, shale property diversity between sand packages, and judgement outside the tools' capability.

After drilling several dry holes onshore US, the exploration VP was reluctant to approve a gas exploration well on a structure with an old well drilled in search of oil before the advent of triple-combo logs. There was a view that the well had penetrated gas, but limited data prevented traditional shaly sand interpretation, and in any case, it had proved unreliable in this area due to variable water salinity. Fortunately, our recent development of an interpretation method based

on "pointers", such as gamma ray versus neutron-density separation, V_p/V_s ratio versus shale fraction, gas records while drilling etc., had created a database of expected resistivity and sonic log responses for gas- and brine-filled sands versus depth, substantiating the view that the seismic feature—a tenuous sag caused by the lower velocity of a gas-filled sequence in the poorly imaged section—was indeed gas. This was confirmed by discovery of a new field.

During the time of low oil prices in the early 1990s, a major North Sea operator's oil field was becoming unprofitable as sales from declining production converged with running cost. Operating company staff were replaced by contractors from Scott Pickford and Edinburgh Petroleum Services to reduce costs and delay expensive abandonment of the massive structure. Our seismic reinterpretation of the structurally complex field found several undrilled fault blocks but did not persuade the operator to drill. It was after all, just another interpretation. Maps of seismic trace-to-trace continuity supported the new interpretation, but significant uncertainties in petrophysical interpretation remained, particularly in assessment of lithology and permeability. We showed that, contrary to received wisdom, the triple-combo logs could be solved for oil, water, shale sand and feldspar—the latter present in volume fractions up to 30% and the key to reliably estimating permeability, and that by recognizing the regional trend in overlying shale properties we could reconcile seismic amplitude at the top of the reservoir with reservoir properties, further supporting our positive reservoir quality interpretation of the target location. The first well of an infill campaign was drilled in 1994, boosting field production of 20,000 barrels of oil and 200,000 barrels of water per day by 15,000 barrels of dry oil. The field was sold to an operator specializing in brownfield redevelopments, who 10 years later used the latest geosteering technology to successfully sidetrack our first well along a shallower trajectory immediately below the overlying shale. A candidate for abandonment a quarter century ago is now the gathering station for numerous nearby satellite fields producing oil that otherwise would have been inaccessible.

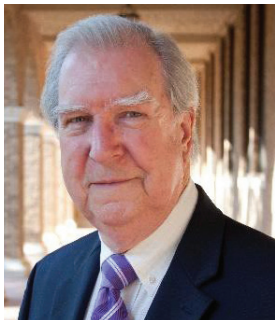
There are several common themes in these examples. Legacy petrophysical analyses were just plain wrong, but the data to do better were available. With the exception of the gas discovery, the vehicle for the updated petrophysical interpretation was simultaneous solution of response equations aimed at overcoming specific shortcomings of the legacy interpretation. The technology was current but not cutting edge. I don't claim personal credit for these examples, as they all required a quorum of individuals who were not prepared to accept the status quo. And while I'm as enthusiastic as anyone about the potential of new technology to enable us to see new things, these successes happened when new eyes using established tools pursued cues missed by others, either via different ways to run the computations, or by appreciating that inconsistent or contradictory evidence may indicate wrong assumptions, not failings in the data.

This article comes 41 years after I arrived in Venezuela to learn to run logs. I was restless, hoping for some adventure, and had no career plan. A fortuitous combination of opportunities and circumstances outside my control mapped out a working life that has taken me from Alaska to Tierra del Fuego, around the world more times than I can remember, and introduced me to wonderful and diverse people dedicated to safely and reliably supplying the earth's population with affordable energy, while minimizing adverse effects on the environment. Counsel for younger readers...

Temper enthusiasm for new technology with skepticism. If the paper's author claims that the answer product from a new logging tool finds more oil than previous calculations, read between the lines. Validate the assumptions of the model and persuade yourself that the comparison was relative to the best possible evaluation without the new data. There may be justification for upping the figures but, until they are independently proven, it remains another interpretation, not ground truth.

Ask the old guys to explain how they perceive the limitations of current thinking, how to avoid falling into the traps for the unwary, and what improvements to your work practices could deliver the most return for the least effort. This is particularly true for estimating uncertainty that frequently focuses on the known unknowns while ignoring the more nebulous and potentially much greater unknown unknowns. The Great Crew Change isn't over, and there are many who believe in honoring the legacy of the great names that guided their formative years in petrophysics by supporting the next generation's efforts to question the orthodoxy, train their eyes, develop the skills to exercise their judgment and improve the collective ability to understand and manage the subsurface.

Great Moments in Formation Evaluation, Part 2: Datasets and Data Rooms and How to Avoid the Smallest Room



Richard Bateman

In the late 1970s Petrobras, the Brazilian state oil company, offered the international oil community the chance to take concessions in Brazil. They prepared a massive data set that interested parties could purchase and review at their leisure in a data room, as a preliminary to making bids on the areas that were up for grabs. Amoco International, along with many other oil companies, decided to purchase a copy of the dataset, which consisted of geologic maps, seismic sections, well logs, core descriptions, well-test results etc., and sent a representative (a Mr. Richard King) down to Rio de Janeiro to make the purchase and bring the boxes of data back to Chicago. The purchase price was a quarter of a million US dollars.

Mr. King carried with him from Chicago a certified check for the $250,000, which he guarded with his life until he got to the Petrobras offices and exchanged it for three massive boxes of paper. The next day he checked out of his hotel, loaded the boxes into a cab, with difficulty, and headed out to the airport. Wanting to be sure that he would not miss the flight he got there three hours before scheduled departure time. He tipped two porters handsomely for their help in depositing his treasure at the appropriate airline check-in point.

At that point Mr. King's problems started. No one was at the desk. In fact there was a little notice to passengers stating that check-in would not commence until at least another hour had passed. Within minutes Mr. King got what we may euphemistically refer to as a 'call of nature'. He looked around to see if there was a convenient restroom, but there was none at hand. He sauntered a short distance away to checkout the lie of the land, while still keeping his quarter-million dollar treasure in view. At last he spotted a men's room way down at the end of a long passage, miles away.

He then had to make a difficult decision. Either he could run down to the restroom, complete his task as quickly as possible and risk that, in the meanwhile, someone would walk off with his three boxes, or he could forget about the restroom for another hour and be secure in the knowledge that his boxes were safe and his future with Amoco would also be secure. The thought of what might happen were he to return to Chicago headquarters without either the check or the dataset only served to increase the urgency with which he knew he *had* to answer nature's call.

As a compromise he decided to rehire the porters and have them accompany him with the precious cargo to the restroom. This plan, however, failed to work since the porters were nowhere to be seen. Eventually he was forced to embark on an odyssey that involved hauling each box, one at a time, part way to the restroom while keeping the rest of them in view before doubling back to get the next one. After single-handedly shuttling the cargo to the john he stacked them up outside his stall and left the door cracked open while he relieved himself, never for a moment taking his eye off the prize. His back ached for weeks afterwards.

The moral of the story is threefold.

- Do not to get to the airport too early;
- Do not to overrate the value of three very heavy boxes full of very boring bits of paper; and,
- Do as your mother always told you, go to the bathroom *before* you leave the house.

Let Us Have Some Fun and Play Petro-Sudoku!

Carlos Torres-Verdín

The following are the solutions to the Petro-Sudoku questions posed in the July 2018 issue of SPWLA Today:

(a) Case 1

(b) Case 5

(c) Case 4

(d) Case 3

(e) Case 6

(f) Case 2

New Petro Puzzle:

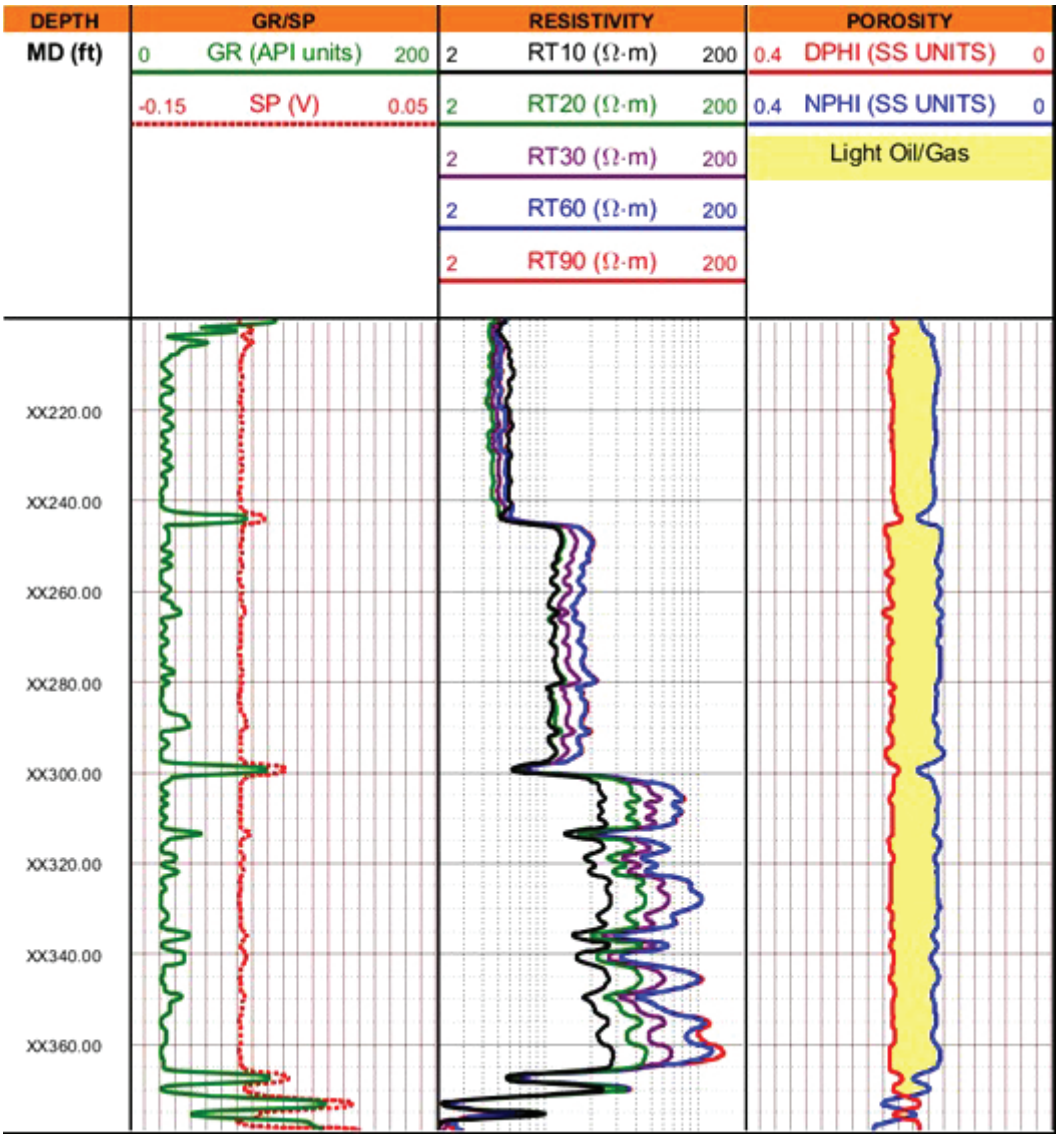
The figure below shows wireline logs numerically modeled across a vertical well penetrating a gas-saturated, siliciclastic sedimentary sequence at irreducible water saturation. Formation dip is zero. The logs were simulated 3 days after the onset of water-base mud-filtrate invasion. Resistivity logs were simulated assuming an induction tool with five depths of investigation, RT90 and RT10 being the deepest- and shallowest-sensing resistivity logs, respectively. Neutron and density porosity logs are plotted in sandstone porosity units.

Which of the following depths exhibits the greatest permeability and why?

(a) XX220 ft MD

(b) XX270 ft MD

(c) XX330 ft MD


DEPTH
MD (ft)
GR/SP
0
GR (API units)
200
-0.15
SP (V)
0.05
RESISTIVITY
2
RT10 (Ω·m)
200
2
RT20 (Ω·m)
200
2
RT30 (Ω·m)
200
2
RT60 (Ω·m)
200
2
RT90 (Ω·m)
200
POROSITY
0.4
DPHI (SS UNITS)
0
0.4
NPHI (SS UNITS)
0
Light Oil/Gas
XX220.00
XX240.00
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SPWLA Young Professionals Newsletter

the bridge

September 2018

In this edition:

My Journey to Science and Engineering of Rocks: Amalgam of Dream, Strive, and Joy

Zoya Heidari
Assistant Professor
The University of Texas at Austin

My Adventure Started Very Simple. My enthusiasm for geosciences blossomed during my childhood, when I was hiking with my parents in mountains and my father was talking about the rocks surrounding us with an unbelievable passion. He was holding a piece of rock in his hands and could not stop talking about it. I was always wondering how he could narrate such a lengthy story just by looking at a random rock! They were not just simple random rocks to him. He was reading them like a book of "Rocks Empire" history! My father is a geologist and my mother is a mathematician/statistician. I guess this combination naturally raises a rock scientist. However, my journey to become a petrophysicist has not been that straightforward. When I was a little girl, I fell in love with the sky and wanted to become an astrophysicist. Physics became the passion of every day of my life. At the same time there was an engineer growing inside me. I once tried to make my own telescope, rubbing a piece of glass patiently with my hands for a long time to make a concave mirror. I was very fortunate of going to a school that valued creative thinking, when I was a teenager. Those were the days when I started experiencing sleepless nights to finish small physics projects, designing experiments to figure out why Benham's black and white disks appear colorful, or waiting long hours in cold deserts at night to observe beautiful shower of meteors in the endless fascinating sky, thinking about the uncertainty in the existence and reliability of what I could see in the sky.

A New Adventure Growing from an Old Passion. The love of understanding the universe remained as a side activity in my life and I decided to pursue mechanical engineering in college. I switched to many subdisciplines of mechanical engineering starting from fluid mechanics, to solid mechanics, robotics and inverse problems, artificial intelligence, and biomechanics. Part of my journey as a mechanical engineer led me towards investigating mechanical properties of bones and analysis of measurements performed on soft and hard tissues of human body. It was indeed the start of my research transition to physics of porous media and signal analysis. One day, I sent an email to Dr. Torres-Verdin to see whether there is an opportunity for me to advance my education in physics of rocks. In less than a day, he responded to my e-mail, invited me to join his research team, opened the gate to the wonderful world of Formation Evaluation, and initiated a beautiful adventure in science and engineering of rocks for me. I consider this moment as a magical point in my life, where all my research passion in physics, engineering, and understanding the universe got linked to what I started with as a little girl, ROCKS!

Dream Big and Nothing Can Stop You. The first and most important rule of my adventure is DREAMING BIG! I consider myself very lucky because I was raised in a family that highly values women's education and rights. My parents raised me with the mindset that impossible does not exist and I am capable of achieving whatever I dream of. Later, I got the chance to share my life journey with a partner who considers my career and dreams as important as his and places my big dreams as our priority plans. However, we all know that painting a wonderland in our dreams and having well-wishers around us are not enough to get us where we want to be. Being a female engineer, I sometimes needed to work harder and have more significant achievements to be equally valued compared to my peers or to be considered "good enough." I have heard NO many times in my life, because of my gender, age, biased judgment on my capabilities and strength, and other factors that I have had no control on. In my very first job interview (when I was a graduate student in mechanical engineering), I was offered a position to develop course materials and notes to be taught by male instructors.

Call for anecdotes and photos:

It's time for a change! Instead of always having a long article, we decided to shift gears and call for photos and short anecdotes. For outsiders, the oil and gas industry calls to mind images of big machines, stinky work environments and coveralls stained with grease and crude oil, but we know that is not our true face. We all have fun and exciting moments, memories that make us smile. Why not share them with colleagues?
Send your stories and photos to spwlayp@spwla.org.

I asked to be given permission to teach. The answer was NO, and the reason was simple and deeply painful: the management mindset of the company was that technical materials delivered by a female instructor would not be well perceived in a male-dominant field. I left the negotiation table that day and never looked back, but I was determined to bring a change through education, so that no one ever gets such an offer. I have experienced many moments of doubt and failure, when I just wanted to stop or to escape from my dreams. But, I have survived each and every one of those occasions, because I know that the only way to survive is "to be resilient and to continue," as my mother used to whisper in my ears.

In approximately five years after that first job interview, Texas A&M University invited me to join their faculty as an Assistant Professor to teach, to develop, and to establish a research program on Formation Evaluation. This was a unique opportunity for me to start a career I had always dreamed of. Pursuing an academic career comes with its own costs and challenges. I accepted the challenge, joined academia, and never regretted the decision I made. Four years after starting my academic career as a university professor at Texas A&M University, I decided to return to The University of Texas at Austin as a faculty member, where my academic adventure in petroleum engineering and geosciences started in the first place, and where later I received tenure.

I love my academic career for four unique reasons. First, it gives me the freedom to work on each and every research question that interests me. I pick a piece of rock and imagine myself sliding into an undiscovered maze, listening to and enjoying the symphony of rocks and fluids. I think about the world of unknowns in this complex and exciting maze, and each one of them can be a potential research problem to be solved. Second, my academic career has given me the opportunity to educate and work with students, the next generations of engineers and scientists in my field, who can initiate massive changes in the world. No words can describe what a splendid feeling it is to receive a phone call, a text, or an email from a former graduate/undergraduate student and to learn about their achievements in life and career or to observe my current or former students growing, shining, pioneering new methods in our field, and achieving their career goals. Third, my students and I have the chance of experiencing countless fulfilling and joyful moments of new discoveries. Any one of these new findings and developments has the potential of solving a challenging problem in our industry. My students and I have published and presented more than 120 publications in conferences and journals of SPWLA and its sister societies such as SPE, SEG, and AAPG, some of which received awards such as distinguished presentation recognitions from SPWLA as well as Cedric K. Ferguson medal from SPE. Finally, my team and I have the opportunity to collaborate with several industry partners and observe the direct application of our research findings and developments on energy-related problems in real life, which makes our work truly meaningful and enjoyable. To enhance and expand these types of collaborations, I established the Texas A&M Joint Industry Research Program on "Multi-Scale Formation Evaluation of Unconventional and Carbonate Reservoirs" in 2012, and the University of Texas at Austin Industrial Affiliates Research Program on "Multi-Scale Rock Physics" in 2016.

Finding Joy in Research. It is very exciting for me to develop methods to reliably figure out how the subsurface, something that cannot be seen directly, looks like with all the details and components from pore to reservoir scale. We are interested in seeing the big picture, but each piece/component is still important. This game never gets repetitive. My team's research focuses on developing experimental, analytical, and computational methods and fundamental rock physics knowledge for enhanced reservoir characterization using integrated evaluation of multi-scale formation data. Our new rock physics models/methods honor realistic and quantitative rock fabric, pore geometry, geochemistry, and solid-fluid interfacial interactions and bulk properties. The impact of our work is on improved description of multiphase fluid transport in spatially complex reservoirs, such as carbonates and organic-rich mudrocks, with the intent to enhance production and recovery factors in these reservoirs. Developing novel methods and understanding mysteries of complex formations are full of joy for me. It brings satisfaction to my career when these new findings are applied successfully to actual energy-related problems in our industry.

Uphill Battles of Life and Career. Every now and then I decide to challenge myself and to leave my comfort zone. Leaving comfort zones can be exciting, because I get the opportunity of expanding and advancing my research, becoming stronger, and experiencing new adventurous moments, but at the same time such decisions can end up to an uphill battle. The good news is that there are always wonderful people who are ready to take your hands and to support you. My life and career has been full of these wonderful people, whom I am sincerely grateful to. Examples include my supervisors, mentors, friends and family, industry collaborators and sponsors, and technical societies, among whom I would like to highlight the role of SPWLA and its wonderful members. They have always been encouraging and supportive to my career and my research team and activities. I joined SPWLA more than 10 years ago when I was a student. SPWLA has provided me, and my research team a platform to present our research findings and to receive invaluable feedback (sometimes harsh, sometimes encouraging, but always constructive) for our further growth and developments.

Contribute to the Growth of our Technical Society and Community. My philosophy about volunteer service to my professional societies and the community is that giving makes the world a better place to live for all of us. I owe my success to all who helped me voluntarily to learn, to persist, and to progress. I would like to do the same for others to ignite impactful changes in the world. Furthermore, I believe each and every service to the community and the professional societies is a learning opportunity and a great chance to meet and collaborate with others. Since joining SPWLA, I volunteered to serve on several technical/educational committees

and events. It was relatively early in my career when SPWLA membership elected me to serve on the SPWLA board of directors as the Vice President of Education (2016–2018). This unique opportunity helped me to promote modern and diverse techniques for advancing worldwide education in the field of formation evaluation and to encourage students' engagement in SPWLA activities. Thank you SPWLA for giving me the opportunity to serve!

Final Words. I have experienced and observed many moments of disappointment and success, which have proven to me that not every single step of career or life journey has to be perfect to live a wonderful life or to have a successful career. Life can be full of uphill battles, especially when you try to step up and leave your comfort zone. Learn to dance in the uphill battles of your life! Stay Strong! Dream BIG! and Nothing can Stop You! You will make it not only to the top of the hill, but also to the top of the highest mountains of the wonderland of your imagination.



The Road Less Traveled turns into the Yellow Brick Road

Thuy Rocque
Retired Director of Petrophysics
Anadarko Petroleum Corporation

It's been 18 months since I retired following a career spanning 31 years in the industry that has seen the best of times and the worst of times…nope, not the film industry, I'm talking about the oil business! Even with all the ups and downs, I look back at my career with great fondness full of wonderful memories of great colleagues and rewarding stories of technical and personal achievements. In my humble opinion, one of my greatest achievements was to bring petrophysics to a status it deserves within my own companies and the industry, and cultivate the next generation of petrophysicists, especially women.

My own path to petrophysics was quite an accidental one and definitely "the road less traveled". I graduated from The University of Texas with a BS in Petroleum Engineering in 1985…oh yes, you either remember or have read about it being the downturn in the oil industry. Many of my classmates did not get job offers upon graduation and some even got their offers rescinded. I'm not sure if many of you "old timers" had this experience at your university, but at UT Austin in 1985 during the bust, not many companies came recruiting and or had positions to offer compared to the number of engineering graduates so they instituted a 'bidding system' to get interviews! No more camping out in front of the placement office the night before to be first in line to sign up for interviews. Each graduating senior was awarded the same fixed number of points and they used those to "bid" for interviews with companies that they wanted. One strategy was to spread out your points and bid a few points on all companies and hope to get at least a few interviews. Another strategy was to bid all your points on the one or two companies that you really, really wanted to interview with. However, just like a TV game show, there was a twist. If you had a past or current scholarship with a particular company, you got a "free" interview without using any of your points. Furthermore, if a company "invited" you to interview based on your academic achievements or internship experience, you didn't need to use points! Whoa, that made a huge difference for me since I had several scholarships and a few companies invited me to interview so in the end, I was extremely lucky to get three job offers upon graduation and chose ARCO Oil & Gas as an entry level Engineer (since I had interned with them in previous summers). *Tip Alert: get good enough grades to earn some scholarships and always, always find a summer internship even if all you do is ride around the field painting pumping units or sit in the backroom doing data entry!*

So, I moved to Tyler, Texas, and started my extensive year long EDP (Engineer Development Program) where I rotated through all aspects of Engineering including Field Operations, Drilling, Production, and Reservoir, working all the oil and gas fields in East Texas. I especially liked Reservoir Engineering so after that first year, I was assigned to the Gulf of Mexico region as one of their junior reservoir engineers in Lafayette, Louisiana, for the South Pass Block 61 field. Oh boy, the stories I can tell you about being the only female AND an engineer AND Asian out in East Texas and on the offshore platform in 1986! Needless to say, there was no #MeToo movement and the term "sexual harassment" was not in the oilfield glossary because I suffered verbal harassment in the form of taunting and teasing like "Is that wrench too heavy for Miss Princess Engineer?…OK, being a 21-year old woman all of 5' 2" and weighing 105 pounds at the time, didn't help, "Women should be at home with the kids and not out on the platform taking men's jobs", and here's my favorite, not from

the men, but from their wives "Don't you dare flirt with my husband when you're out there". So, as soon as this woman said this to me, I looked over at her husband and said "Lady, you don't have ANYTHING to worry about!". To be fair, not all of the men were mean, there were many gracious and good-hearted men who welcomed me and took me under their wing…and I even got a few occasional marriage proposals! *Tip Alert: stand up to people without being mean even if they say mean things to you, do your job really well and people will respect you regardless of your gender or age.*

Back in the 1980s, most companies had multiple district offices close to the oil and gas fields and the corporate office. ARCO also had a world-class Technology & Research Center so as a three-year engineer, I was selected to be transferred to ARCO's TRC in Plano, Texas, to gain experience in ALL functions of a Reservoir Engineer including conducting large-scale field studies, core analysis, petrophysics, reservoir characterization, and reservoir simulation. It was a dream position to work and learn among industry giants in each of their specialties. They were some of the most elite researchers who have developed and published many of the industry's standards that we still use today—we're talking about people who have equations named after them!!! I learned so much during those years at the TRC about the entire life cycle of acquiring geological, petrophysical and engineering data, data QC, data analysis, collaboratively working in a multidisciplinary team to create reservoir models and simulation models and then running multiple development scenarios for the assets, and ultimately running economics to high grade how a field should be developed. It was determined that I would transfer back to one of the district offices (both Long Beach and Anchorage offices offered me positions) and be assigned my own field to lead after acquiring all this well rounded technical experience but it was my final rotation in the Petrophysics group that hooked me. I discovered that it fit all of my technical curiosity and skills but my mentors and managers all said that I should stay in Engineering because the other path is "the road less traveled," let me explain.

The conventional wisdom and practice has been for logging engineers and geologists to migrate into being log analysts or petrophysicists. Most "logging engineers" are either electrical engineers or physicists who understand all the logging tool physics and how they acquire data downhole. Some "logging engineers" have a geological background and understand the rocks that affect the tool responses. Therefore, it's natural that these logging engineers eventually shift from acquiring data to analyzing data and be log analysts (which is the term used historically). Petrophysics to me is the prime intersection and bridge between geology and engineering. So, for a petroleum engineer, such as myself, several geology courses were required as part of our curriculum so that I acquired a rudimentary but good enough understanding of mineralogy and depositional environments (just don't ask me to contour a map or draw in 3D). But an engineer is fairly adept at physics and mathematics so it was very natural to me when I had to deal with all those petrophysical equations…did you get that? Let me repeat, petrophysicists deal with a lot of equations to calculate parameters, such as shale volume, porosity, permeability, and saturations then deal with error bars and precision and accuracy.

The other part of being a petrophysicist that I like is working with other disciplines in a collaborative environment so petrophysics is in an ideal position working with geologists and geophysicists to accurately describe reservoir properties to determine the quality of certain formations. It is also critical that petrophysists work with engineers to ensure that the calculated reservoir properties match reservoir performance such as flow rates and reservoir pressure so there's a continuously iterative process between petrophysics, G&G, and engineering to come up with the most representative and accurate model that honors all types of data. So if you like working on a multidisciplinary team and being in the center of it all, petrophysics is an ideal discipline for you. *Tip Alert: if you find something that peaks your intellectual curiosity and it fits many of your technical skills, there's a chance that's the right career path for you EVEN IF you haven't seen anybody else do it or seen someone that looks like you in that career.*

This was an epiphany for me and that's how my accidental career path in petrophysics began. I've held engineering positions as well as petrophysics positions during the first half of my career but I really focused on petrophysics the last half of my career. I was fortunate enough to be promoted to Petrophysics Manager in 2004, and that is when I began making my mark in the industry.

In my opinion, the giant discoveries in the Gulf of Mexico and internationally in the 1980s and early 1990s somewhat "diminished" the need for petrophysics. Let's be real, when reservoir porosities are 20+ to 30+% and permeabilities are in the Darcies, it's not that hard to calculate that from logs or cores. I know because I was a petrophysicist at that time and the joke is all you need to do log analysis is the "thumbs out" technique! If your left thumb goes to the left indicating sand from the GR or SP and your right thumb goes to the right indicating high resistivity then you've got hydrocarbon! Most of the formations were clean and fairly homogeneous with single-phase HC so the tool responses were easier to interpret. As the industry drilled deeper in the GOM to Lower Miocene and Tertiary formations the discoveries became more heterogeneous, reservoir quality decreased, more deep gas reservoirs were discovered, and log interpretations became more challenging and the need for an experienced petrophysicists increased. But it was the 'shale revolution' that brought petrophysics to the top of the food chain!!! Holy cow, how do you accurately measure and calculate microdarcy permeability or low single-digit porosity in rocks as tight as bricks! Unconventional reservoirs brought many innovations to the core analysis and petrophysics communities and turned them into superstars. *Tip Alert: sometimes you are lucky to be at the right place at the right time in the industry so enjoy the ride but continually assess if your skills are being sought after and if not, learn those skills and potentially pursue those career paths.*

Back to shales, I recall my own petrophysics group at Anadarko in 2007 providing support across the company, primarily in GOM and International, and very few staff supporting mature conventional onshore fields. We started working the Marcellus and Haynesville and quickly realized I didn't have many staff in my group (or the company) that had unconventional experience except for one person who had worked the Barnett Shale for Mitchell Energy. As Anadarko's interest in shales increased due to our existing acreage (along with the rest of the industry), I foresaw a great demand for petrophysicists within Anadarko and within the industry, and possibly a shortage due to the mature petrophysical community. At that time, large independents like Anadarko primarily hired experienced

petrophysicists from other companies or service companies and didn't have the infrastructure to hire entry-level petrophysicists or college graduates to train as petrophysicists. I took the bold move of proposing to upper management that not only did we need to centralize petrophysics AND increase staff, we also needed to create a petrophysics recruiting and grassroots training program to make our own petrophysicists, as there would be a big shortage in the industry and we needed to be at the forefront of this trend and hire top talent. Well, even though I had a crystal clear vision of this petrophysical utopia, nobody else saw it with me because it took about two years of countless presentations and negotiations (not all were pleasant) to convince our management to approve my proposal that a world-class petrophysics group would a big competitive advantage in the current industry environment. *Tip Alert: if you strongly believe in a goal and strategy, be vigilant and pursue that goal even if you fail to get approval a few times. Look at why you failed and ask if it's just a matter of timing or if you missed anything, then redesign your proposal!*

The other part of my strategy was to elevate our company's exposure in the petrophysical community to help with recruiting so I took an active role in SPWLA and became a Board member. That pursuit was also interesting at the time as there were not very many women in the petrophysics field and I was the only female Officer on the SPWLA Board for a few years…we've come a long way since SPWLA elected a woman as President just two years ago. I also did extensive research regarding recruiting and developing new petrophysicists by looking at numerous undergraduate and graduate engineering and geology programs at universities and eventually high-graded four universities that had a graduate program that focused on petrophysics and/or formation evaluation. As it turns out, our most successful recruiting partnership/relationship was with the UT Austin Formation Evaluation Consortium…well OK, it didn't hurt that I'm a Longhorn!

After getting management approval to create a world-class petrophysics department, I developed a five-year plan and began to set up my recruiting program for summer internships, full-time hires, petrophysical curriculum, and a career progression for petrophysicists. *Tip Alert: do your research and gather supporting data for any organizational proposal, especially one that involves a major strategy change or direction*. *Present relevant data that support your recommendations and how the new strategy will benefit the corporation.*

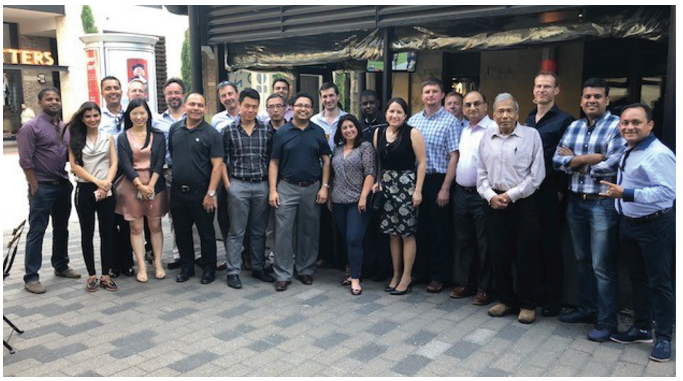
We were extremely successful with our summer internship program by designing relevant and much needed projects that allow us to evaluate a student's technical ability and use the end results in our existing assets. Our program was so successful that even some of the geological, geophysical, and engineering interns in our company started asking how they could learn petrophysics and enter that career path!!! Wow, we were superstars and had groupies! So that started me thinking: If the interns are interested, what about experienced G&G&E professionals? The people I had the most access to were our own internal G&G&E staff so how could I interest/attract mid-career geologists, geophysicists, and engineers in our own company to potentially become petrophysicists??? *Tip Alert: always be on the lookout how you can turn an observation into an idea or an opportunity.*

You see at that time, in the early to mid-2000s, our company (and other companies) and my own group were somewhat bimodal in age and experience and we were not very diverse. I was the only woman in my group and all my fellow Petrophysics Managers in the industry were male. It was funny at times, when I met young professional women for the first time at SPWLA Annual Symposia, they'd say "Oh, I've heard about you, you're THE female Petrophysics Manager." I'm sure there were others but around that time, however, I didn't meet many or else I am way more outspoken than the others…oh well. I actually took those comments to heart and did a lot of things in my career to promote women within Anadarko and the petrophysical community, but back to mid-career recruiting. With the huge success of our entry-level recruiting program, combined with our existing senior-level petrophysicists, we had a hole in the mid-career category. So, for succession planning and sustainability, I also developed a mid-career internal recruiting program by designing a 10-month Applied Petrophysics Mentorship Program where we hold biweekly sessions teaching the fundamentals of petrophysics with an applied project where the attendees bring their own wells or logs or whatever, and are tutored in solving some basic questions. Also, by then Anadarko had developed a great reputation as having a respected group of petrophysicists that offers a good career progression in that discipline so by word of mouth, we began to hire several external experienced mid-career petrophysics and they told their friends and they told other friends and so on! At one time, my group was one of the most diverse in our company with nearly 50% women, and our staff came from seven different countries. *Tip Alert: if you build it, they will come!*

Today, petrophysics and petrophysicists are the cornerstone of many E&P and service companies. No longer are we the lone log analyst crunching numbers on a truck or as a minor member on an asset team or career with limited upward progression and exposure. Petrophysicists are now diverse group with engineering and G&G backgrounds, include both men and women, have undergraduate and graduate degrees, include both US citizens and international, and range in experience from recent college graduates to long-time senior level with 35+ years of experience. Who could've known when I took the petrophysics road that was almost never traveled by a female Asian Petroleum Engineer that I would end up staying on that road, put up signs for others to follow, make improvements to that road to make the path easier for others to follow, and encourage everyone to at least consider visiting that road. *Final Tip Alert: When life presents a challenge, don't ask "Why?" Rather, ask "Why not?"*

SPWLA Networking Happy Hour – August 2018

The most recent SPWLA social activity in the Greater Houston area was well attended and included current and former members of the society's international and regional leadership. More than 30 SPWLA members located in the Houston metro area gathered in a great atmosphere to share drinks, appetizers, laugh and network. Attendees met new colleagues and reconnected with others. Two members of the international board attended: 2018–2019 SPWLA President Zhipeng Liu and 2018–2019 SPWLA President-Elect Jesus Salazar. Furthermore, two past SPWLA distinguished speakers, Gary Simpson and Mayank Malik, and few former regional SPWLA leaders attended the social event. Attendees were grateful for the opportunity to have diverse conversations with their leadership and recognized members, and discuss assorted topics related to the society and oil industry. New members to the industry and SPWLA especially benefited from this direct interaction. Members attending ranged from one to more than fifty years of experience.



Attendees of SPWLA's Happy Hour at Houston's Yard House at City-centre, August 2018.

SPWLA members and petrophysics enthusiasts having a great time in a relaxed atmosphere.

An excellent place close to the world known Energy Corridor in Houston, Texas, was selected to host this event. More than 30 professionals with diverse background and experience enjoyed a beautiful evening with drinks and food onboard. Attendees work with operating, service, and consulting companies in addition to students. This time, several new members and nonmembers interested in petrophysics joined and were excited to be a part of the SPWLA activities. Members attending suggested organizing more of these social events. Food was provided courtesy of an anonymous member who sponsored appetizers for all the attendees.

SPWLA's most recent social event was well attended and included current and former SPWLA international and regional leadership.

SPWLA members were delighted to share a good time with their board members and former distinguished speakers.

Don't miss our next event!

Join us for our next event to kick off the Fall season. Our fourth SPWLA Networking Happy Hour in 2018 will be held at Fuego's Saloon in a very convenient location for everyone in the Greater Houston Area on October 18, 5:00–8:00 PM. The entire SPWLA community is invited, no need to RSVP, come at your own leisure, no payment required. Come and mingle with fellow petrophysics enthusiasts!

Everybody is welcome!

When: ***5:00–8:00 PM Thursday October 18, 2018***

Where: ***Fuego's Saloon, 817 Durham Dr. Houston, TX 77007***

Poem of the Month:

By Kanay Jerath, Anadarko Petroleum Corporation:

I come from many, many miles deep
In cardboard boxes I will forever sleep

You may slab me, and give me some holes
I'll probably get you to some of your Geo-goals

There's a lot to see, a lot to measure
For your petrophysical and plotting pleasure

Look at me carefully, you'll always learn something more

Who am I? Of course, I'm CORE!!

Response to question from previous issue:
Did you attend the most recent SPWLA Annual Symposium in London?

By Adam Haecker
Continental Resources, Inc.

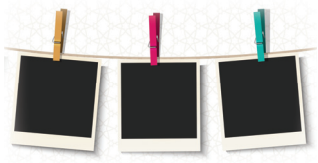
Most everyone, I think, had a great time at the SPWLA Annual Symposium. Selected photos from the Conference are below. There was a bar down the street called the Hung Drawn and Quartered. I wish I had gotten a t-shirt. Additionally, I attached a photo of me next to a telephone box since we no longer have payphones in the USA. I enjoyed the novelty. Finally, here is a very blurry Paul Craddock with a beefeater from the Tower of London.

What is your favorite science or math joke?
Please, send us some nice jokes, memes or comic strips at spwlayp@spwla.org or through SPWLA social media, and we'll choose some responses to publish in the next issue!
Thanks for your participation.

Contact us: SPWLAYP@SPWLA.ORG

We encourage you to contact us with any suggestions for improving our group and/or if interested in participating in our activities.

Send us your articles, stories, fun moments, photos, etc. to be published in The Bridge.



AUSTRALIA CHAPTER
(Formation Evaluation Society of Australia, FESAus)

General News

FESAus, the Australian chapter of SPWLA combines the formation evaluation societies from around Australia, predominantly FESQ. Technical meetings are held in Perth on the second Tuesday of each month, with webcasts of the presentations available soon after for members from other states to view. Please visit www.fesaus.org for meeting information.

2018 Chapter Committee Members:

President	Adrian Manescu
Vice President/Assistant Treasurer/Newsletter Coordinator	Wesley Emery
Treasurer/Company Secretary	Callum Rideout
Website Coordinator/Data Standards Focal Point	Martin Storey
Secretary/Inter-Society Liaison/Social Coordinator/Special Events and Awards	Leanne Brennan
Past President	Nariman Nouri
Monthly Meeting Coordinator	Meretta Qleibo
Membership Coordinator	Siobhan Lemmey
New Technology Forum Coordinator	Ben Van Deijl
New Technology Forum Coordinator	AbdelRahman Elkhateeb
Education Group Leader	Matthew Josh, Paul Pillai
Audio Visual Coordinator	Nigel Deeks
Sponsorship Coordinator	Andrea Paxton
Audio Visual Coordinator	Yang Xingwang
Victoria Representative	Matthew Durrant
NSW Representative	Harris Khan

Recent Events

10 July 2018 – Tim Conroy (Chief Petrophysicist, Woodside Energy) gave a talk entitled, "Accelerating and Enhancing Petrophysical Analysis with Machine Learning: A Case Study of an Automated System for Well Log Outlier Detection and Reconstruction." Tim's talk was well received with a great deal of discussion and sharing of ideas.

14 August 2018 – Ashish Datey (Petrophysicist Domain, Schlumberger) gave a presentation entitled, "Integrating NMR and Spectroscopy Data in Formation Evaluation." Following the lunchtime presentation, Ashish conducted a demonstration and workshop showing integration of conventional openhole, NMR and spectroscopy data using a multimineral inversion to provide rapid formation evaluation. Participants had the option of bringing a laptop running multimineral analysis software and following along in the class. An open-source dataset from a well in Browse Basin was provided. Ashish's talk and workshop in the afternoon was well received with a great deal of discussion and sharing of ideas.

FESAus July 2018 meeting. Speaker Tim Conroy (Chief Petrophysicist, Woodside Energy) (left) receives speaker's gift from Adrian Manescu, Chapter President.

FESAus August 2018 meeting. Speaker Ashish Datey (Schlumberger) (left) receives the speaker's gift from Adrian Manescu, Chapter President.

Upcoming Events

06 September 2018 – Max Podolyak (Corelab) visiting Perth and lunch time presentation.

11 September 2018 – New Technology Forum: Hardware Topic this year – Woodside Auditorium

30 October 2018 – Master Class in collaboration with SPE

"Brown Fields/Production"

13 November 2018 – Matt Shaw will give a talk on "Uncertainty in Petrophysical Properties for Reservoir Modeling."

11 December 2018 – End of Year Event TBA

Please visit the Technical Meetings section of the chapter website www.fesaus.org for details on upcoming technical talks.

QUEENSLAND CHAPTER
(Formation Evaluation Society of Queensland, FESQ)

General News

FESQ is an international chapter of SPWLA, representing the state of Queensland, Australia. Chapter meetings are typically held on the third Thursday of each month. We continue to serve the local community of professionals and researchers with interest in the science and application of petrophysics and formation evaluation. Our focus is on providing information and education that is relevant to our members, with emphasis on unconventional petroleum reservoirs and a growing interest in mining applications. We also promote innovation and advancement of new technologies and support collaboration with other societies that have common interests.

The FESQ committee is well represented by the Queensland-based petroleum and mining industries, state government, and research sectors. The committee meets on the last Wednesday of each month.

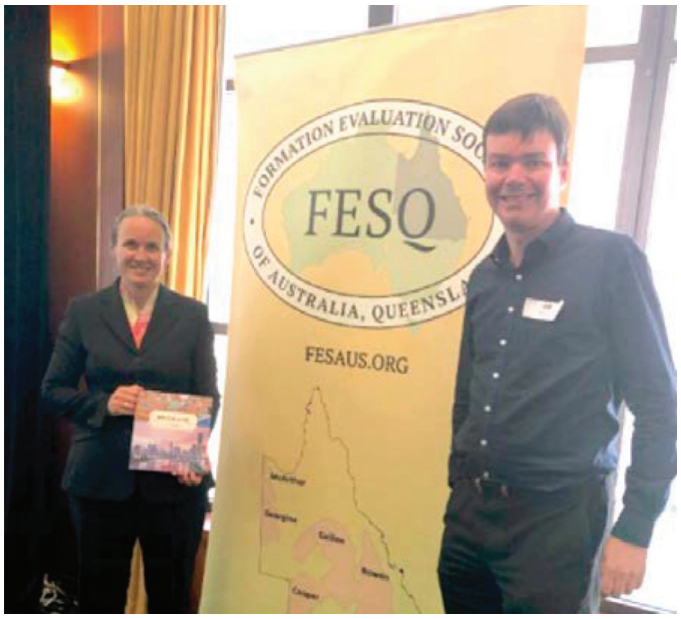
2018 Committee Members

President	Justin Gorton (Department of Natural Resources (Mines (and Energy)
Secretary	Marcel Croon (Weatherford)
Treasurer	Vahab Honari (University of Queensland)
Events Coordinator	Tom Neville (Asia-Pacific Formation Evaluation Services)
Comms. Coordinator	De Nicholls (BHP)
Member	Matt Pfahl (Santos)
Member	Heidi Sutton (Shell)
Member	Kevin Flynn (Flynncore)
Member	Anthony Giambalvo (Santos)
Member	Inamullah Janjua (Schlumberger)
Member	Joseph Lim (Senex Energy)
Member	Rachael Ilett (Senex Energy)
Member	Andrew McCarter (Westside Corporation)
Member	Andy Hall (Pentagram Petrophysics)
Member	Artem Sibgatullin (Arrow Energy)

A focus for the committee early this year was to ensure a full calendar of technical meetings for 2018, which has now been successfully achieved. In addition, we delivered a petrophysics training course in August and will continue with our flagship event, the annual Technology Day, in late 2018. In conjunction with these events, we also organize social functions to provide opportunities for the membership base to network with other professionals and researchers.

Recent Events

24 July 2018 – SPWLA Distinguished Speaker, Jennifer Market (Lloyds Register), traveled to Brisbane to present a talk on "Understanding Sonic Data in Unconventional Reservoirs." The event, which was cohosted by FESQ and the Queensland Chapter of SPE, was held at the Tattersall's Club. It was very well attended by members of both organizations, providing a great opportunity for exposure to some of the challenges faced in North America. The approaches can apply to our coal-seam gas producers as well as the other emerging unconventional explorers in Queensland.



FESQ July 2018 meeting. SPWLA Distinguished Speaker Jennifer Market (Lloyd's Register) (left) with Marcel Croon, FESQ Secretary.

July 2018 – Jesus Salazar, SPWLA President-Elect, visited Brisbane and met with members of the FESQ committee and SPWLA Regional Director, Rick Aldred. A social event followed, which was a fantastic opportunity for our FESQ members to meet and network with the SPWLA President. It also provided the chance to discuss FESQ's aims to grow and better service the industry and research community in Queensland.

July 2018 meeting of SPWLA President-Elect with FESQ Committee member. From left to right, Rick Aldred (SPWLA Director, Asia Pacific), Andrew McCarter (FESQ Committee), Marcel Croon (Secretary, FESQ), Jesus Salazar, Alastair Ong (FESQ)

23 August 2018 – Dr. Walter Keilich (BHP), presented a talk on "Geotechnical Engineering in Mining—What We Do and What Happens When it Goes Wrong." The event was held at BHP's office in Brisbane and was well attended by representatives from both the Queensland petroleum and mining industries. The outcomes demonstrate a growing interest and contribution to petrophysics and geomechanics from the mining industry in the state. As some of the issues faced are similar in nature to the petroleum industry, it provides opportunities to share learnings across both industries.

29–30 August 2018 – FESQ ran a two-day petrophysics course led by Tom Neville. Tom has worked in the industry for close to 30 years in various geoscience and petrophysics roles with much of his career spent with Schlumberger. He is currently Principal Consultant for Asia-Pacific Formation Evaluation Services and on the committee for FESQ. The course covered everything from data acquisition, tool physics, to interpretation and is designed, at a beginner to intermediate level, for professionals, researchers, and technical managers.

Upcoming Events

26 September 2018 – David Titheridge (Consultant) will give a talk on "Determining Cleat and Joint Azimuths from Image Logs and Petal Fractures."

25 October 2018 – Peter Crosdale (Energy Resources Consulting) will be presenting on the "Dangers of T_{max} as an Indicator of Thermal Maturity."

November 2018 – FESQ and SPE will collaborate to deliver the year's flagship event. The Technology Day provides a series of technical talks, poster sessions, along with an exhibition and technology demonstrations. This year, the theme will be broadly aimed at integration across the petroleum and mining industries to share learnings and gain further insight on how petrophysics and the technologies that support it are used across the sectors.

BANGKOK CHAPTER

Recent Events

30 August 2018 – The Bangkok Chapter of SPWLA held a very successful meeting in August, following a break for summer vacation in July. Dr. Guy Wheater (Conveyance Specialist & Consultant with Gaia Earth Sciences Limited) presented a talk entitled "The Curse of Wireline Keyseating and Why it Should be a Thing of the Past". Guy spent the past decade researching the phenomenon of stuck cable, developing and testing modeling software that allows us to predict the sticking risk, as well as hardware to help mitigate the risk. Thanks to Dr. Wheater for sharing his expertise.

Bangkok Chapter August 2018 meeting. Guy Wheater (Gaia) holding his WLSO and WXSO tools.

Bangkok Chapter May 2018 meeting. Andrew Cox (right) presenting speaker's gift plaque to May speaker Khun Numan Phettongkam (Weatherford) (left).

Upcoming Events

26 September 2018 – The Chapter will host a talk by Alexander Belovich (Baker Hughes GE) entitled "The Problem With Silt in Low-Resistivity Low-Contrast (LRLC) Pay Reservoirs."

BRAZIL CHAPTER

General News

Our monthly meeting is held every third Tuesday of the month, at 4 PM in downtown Rio de Janeiro. Anyone wishing to participate or receive information about the chapter can contact our secretary, Andre Bertolini (abertolini@slb.com). We also post chapter updates on our Facebook page (fb.me/SPWLABrazil) and our LinkedIn page—check us out!

Recent Events

19–21 June 2018 – The 2nd Brazilian Petroleum Conference, whose theme was "Carbonates: Advances and New Challenges in E&P," was held in Rio de Janeiro. The SPWLA Brazil Chapter was part of the organizing committee, together with Petrobras, and the local chapters of SPE, SBGf, and ABGP. SPWLA members gave three presentations and were involved in joint sessions for formation evaluation. The session sponsored by SPWLA Brazil Chapter included the following presentations:

- Maria Boya Ferrero (PDO) – "Risk and Opportunities related to the understanding of fluid-fill-cycle: lessons learnt in the Sultanate of Oman"
- Carl Sisk (InGrain/Halliburton) – "Digital Rock Petrophysics"
- Nadege Bize-Forest (Principal Research Geologist, Schlumberger) – "Using Machine-Learning for Depositional Facies Prediction in a Complex Carbonate Reservoir."

Brazilian Petroleum Conference June 2018. Fernanda (UFRJ Student Chapter), Renata (UFRJ Student Chapter), Fernando (Petrobras, SPWLA Brazil Chapter Students and Young Professionals director), Raissa (UFRJ Student Chapter) and Nadege (Schlumberger, SPWLA Latin America president) at BPC.

Brazilian Petroleum Conference June 2018. Marcio Spinola (SPE, Halliburton) and Nadege Bize-Forest (Schlumberger, SPWLA Latin America president) at BPC, following Nadege's presentation.

We congratulate the UFRJ student chapter for their support and active participation. More information about the event can be found on the website: http://www.bpc2018.com/home/

26 June 2018 – Nadege Bize-Forest presented her paper from BPC at our monthly meeting.

17 July 2018 – Milena Siqueira (Ingrain Halliburton) presented the paper "Estimation of Permeability, Porosity and Rock Compressibility Properties Using Digital Rock Analysis Technique for a Heavy Oil Unconsolidated Sandstone Offshore Brazil".

Brazil Chapter July 2018 meeting. Milena Siqueira (Halliburton) (right) and Mateus Barroso, SPWLA Brazil Treasurer (left).

Upcoming Events

25–28 September – UFRJ SPWLA and AAPG student chapters are organizing the 2nd UFRJ Petroleum Geology Week (SEGEP). SPWLA Brazil Chapter will be a financial sponsor and support the conference with technical lectures.

DALLAS CHAPTER NEWS

General News

We would like to thank the members of SPWLA Dallas Chapter who attended meeting during the 2017–2018 season. We appreciate your support and we also wish to express our thanks to the guest speakers who made the effort to visit us.

The monthly lunch meetings resume in September.

Chapter officers for the 2018–2019 year are:

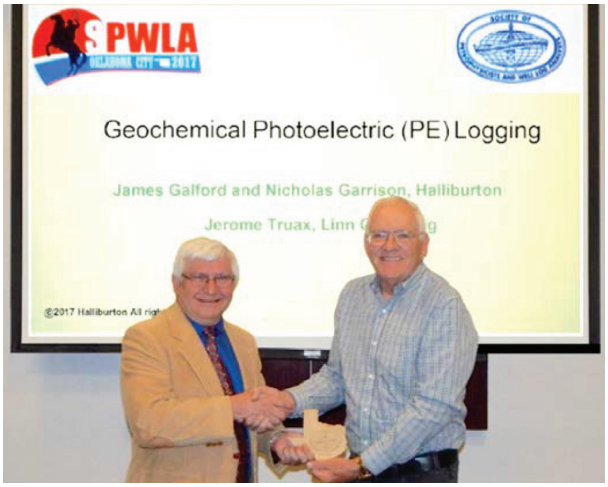
President	Mriganko Sarkar (Pioneer Natural Resources)
VP Technology	Steve Brakeen (Primexx Corporation)
Secretary	Violeta Lujan (Schlumberger)
Treasurer	Ray Wydrinski (Pioneer Natural Resources)

Recent Events

08 March 8 2018 – Aidan Blount (Shell) gave his SPWLA Distinguished Speaker's presentation "Lessons Learned in Permian Core Analysis: Comparison between Retort, GRI and Routine Methodologies." This talk had full attendance and was very well received by the audience.

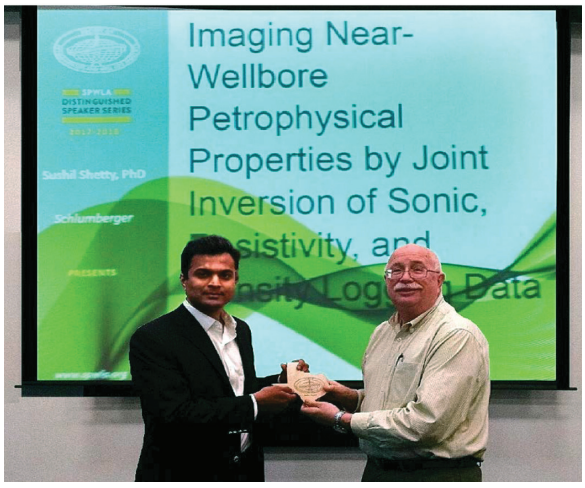
Dallas Chapter March 2018 meeting. Aidan Blount (left) receives the SPWLA speaker's award from Violeta Lujan (right), SPWLA Dallas Chapter Secretary.

12 April 12 2018 – James Galford (Halliburton), an SPWLA Distinguished Speaker put into perspective how lithodensity photoelectric (PE) logs can only be obtained in wells drilled with modest mud densities, and logs can be compromised by loss of contact between the pad and the borehole wall. A useful substitute can be obtained from neutron-induced gamma-ray spectroscopy logs when borehole conditions are not suitable for lithodensity PE tools.



Dallas Chapter April 2018 meeting. Jim Galford (Halliburton) (left) from Halliburton receives the SPWLA speaker's award from James Lewis, President Emeritus of the SPWLA Dallas Chapter.

09 May 2018 – The final presentation of the 2017–2018 SPWLA Dallas Chapter session was by SPWLA Distinguished Speaker Sushil Shetty (Schlumberger) on "Imaging Near-Wellbore Petrophysical Properties by Joint Inversion of Sonic, Resistivity and Density Log Data." This presentation generated a lively question and answer session between the audience and the presenter.



Dallas Chapter May 2018 meeting. Sushil Shetty (Schlumberger) (left) from receives the SPWLA speaker's award from Ray Wydrinski, Treasurer of SPWLA Dallas Chapter.

DENVER CHAPTER
(Denver Well Logging Society, DWLS)

General News

Join us for the monthly DWLS meetings, which are held the third Tuesday each month, beginning in September and running through May. Meetings take place in the Mercantile Room at the Wynkoop Brewing Company in downtown Denver, Colorado. The networking social begins around 11:20 AM, lunch is served at 11:45 AM, and the technical presentation starts at 12:00 PM. The cost for the DWLS luncheon is $20 and guests are welcome to attend. Visit the DWLS website at www.dwls.spwla.org to make your luncheon reservations, renew your membership, or join the society.

The DWLS is sponsoring scholarship and grant opportunities for graduate students attending a college in the United States Rocky Mountain region, which includes the states of North Dakota, South Dakota, Colorado, Wyoming, Utah, Idaho, Montana, New Mexico, Arizona, and Nevada. Graduate students who are pursuing a degree in a field related to upstream oilfield well log interpretation, specifically petrophysics, geomechanics, geophysics, petroleum, or geology, are encouraged to apply. Application materials and further details are available on the SPWLA website.

Upcoming Events

18 September 2018 – Pavel Syngaevsky (Noble Energy) will give the presentation at the first meeting after the summer hiatus. The subject of the talk is characterizing pore structure in North American carbonate mudstones. Understanding pore structure has a significant impact on understanding formation fluid volumes and deliverability, but is complicated in unconventional rocks by small and variable pore sizes, interaction of water with clay minerals, mixed mineralogy and wettability, and adsorbed hydrocarbons. Studies of carbonate mudstones from Texas to Canada reveal similarities both in petrophysical challenges and possible solutions.

DWLS September 2018 meeting. Pavel Syngaevsky (Noble Energy) is the presenter.

02 October 2018 – DWLS will cohost the Fall Workshop with RMAG in Golden, Colorado. The workshop will address the question, "What have we learned from unconventional reservoirs that could be applied in any petroleum system?" Visit the DWLS website at https://dwls.spwla.org for more information.

JAPAN CHAPTER
(Japan Formation Evaluation Society, JFES)

General News

We kicked off 2018–2019 activities with the renewed board members here in Japan. We are now working as one to achieve a successful 2018 annual symposium. Recent exciting news for the Chapter was that Mr. Belmiro Claudio de Aime, who was nominated by JFES won 1st prize in the student competition at SPWLA 2018 in London. Congratulations!

Recent Events

20 July 2018 – The 104th Chapter meeting was held on 20 July at OYO Corporation, Saitama, Japan. The meeting was held in collaboration with the civil engineering industry. Two topics were presented:

Sachiya Yokoyama – "Outline of a New Hydraulic Fracturing Technique for Rock Stress Measurement"

Yoshihiro Yamashita – "An Application Example of Machine Learning to Shallow Subsurface Exploration using Ground Penetrating Radar."

It was beneficial to learn of the stress magnitude methodologies and of the application of recent digital technology for geophysical surveys in the civil engineering industry, as they were new for us in E&P.

JFES July 2018 meeting. Dr. Sachiya Yokoyama presenting.

Upcoming Events

11–12 October 2018 – The 24th Formation Evaluation Symposium of Japan will be held at Japan Oil, Gas and Metals National Corporation - Technology & Research

Center (JOGMEC-TRC), Chiba Japan. The special session will be on "Complex Reservoirs". Please join us!

THE NETHERLANDS CHAPTER
(Dutch Petrophysical Society, DPS)

Recent Events and General News

28 June 2018 –DPS had a technical seminar on rock physics and also held the annual general meeting. Dr. Aletta Filippidou (Shell) gave a presentation entitled "The Acoustic Signature of Deformation in the Lab," and Reza Saberi (CGG) gave a presentation on "Rock Physics Integration: From Petrophysics to Simulation."

DPS June 2018 meeting. Speakers Aletta Fillipidou (Shell) (left) and Reze Saberi (CGG) (right) being congratulated by former DPS President Tom Bradley (at their left).

The Annual General meeting reviewed the last year's DPS activities and an overview of the 2018 SPWLA Annual Symposium was presented. Also, the new board was presented with Iulian Hulea (Shell) becoming the new DPS president. In addition, Chris Harris (Shell) has joined the board as VP Technology.

Upcoming events

20 September 2018 – The next DPS technical seminar will be held at KIVI, The Hague, The Netherlands.

DPS June 2018 Annual Meeting. Iulian Hulea, the new Chapter President (right) with former DPS President Tom Bradley (left).

NIGERIA CHAPTER

General News

It is our pleasure to introduce to you the following SPWLA Nigeria Chapter Officers:

President	Dapo Adeyemo (Chevron)
President-Elect	Bode Awuyo (Emerson-Paradigm)
VP-Technology	Chidozie Nwagbara (Schlumberger)
VP-Education	Matthew Ogofa (Chevron)
VP-Publications	Emmanuel Egbele (Total)
Executive Director	Gabriella Ogu (APWLA)

To register a nonprofit organization in Nigeria requires three people to be on the board of trustees who are held responsible for the behavior of the organization.

Recent Events

30 May 2018 – Hamisu Magaji (Addax Petroleum Nigeria) gave a well-attended presentation Paper "An Integrated Approach to Real Time Characterization for Well Placement Optimization."

Nigeria Chapter May 2018 meeting. Hamisu Magaji (ADDAX Petroleum) giving his presentation.

25 July 2018 – Chikezie Nwosu (Deputy Managing Director of Addax Petroleum Nigeria) gave a talk entitled, "Development Challenges of Low-Contrast Low-Resistivity Pay."

Nigeria Chapter July 2018 meeting. From left to right: Emmanuel Egbele, Bode Awuyo, Dapo Adeyemo, Chike Nwosu (speaker), Chidozie Nwagbara, and Joseph Otevwemerhuere (Addax Petroleum and on APWLA board of trustees).

Upcoming Events

25 September 2018 – The next technical meeting.

SAUDI ARABIA CHAPTER (SAC)

General News

Following a successful year and half as President, and winning the SPWLA Best Chapter award in 2017, Dr. Tareq Alghamdi (Saudi Aramco) turned over the Presidency of SPWLA Saudi Arabia Chapter (SAC) to Dr. Faisal Alenezi (Saudi Aramco) on 1 July 2018. The new SPWLA SAC board would like to thank Tareq for his outstanding services and contributions to SPWLA SAC and welcome Faisal in his new role. Faisal is in the process of building and expanding his new teams for the upcoming year.

Recent Events

2–6 June 2018 – Amjed Hassan, a PhD student at KFUPM and winner of the 2017 SPWLA SAC/SPWLA-KFUPM Chapter Student contest, presented his research paper "Determination of Water Saturation Distribution for Complex Reservoirs" at the SPWLA 59th Annual Symposium Student Paper Contest in London, UK. Amjed's research work includes development of a new mathematical tool and methodology for determining the water saturations in complex reservoirs. The developed model is targeted to determine water saturation for dual and triple porosity system using NMR and other logging data. NMR measurements are used to obtain the volume fraction of each pore network, then, water saturation is determined using the resistivity and porosity logs. This study demonstrates that the developed models proffer petrophysicists more flexibility to capture the impacts of pore structure in evaluating complex formations.

Amjed Hassan a PhD student winner of the 2017 SPWLA-SAC/SPWLA-KFUPM Student Chapter Contest.

Amjed Hassan with other international students who participated in the Student Competition at the 2018 SPWLA 59th Annual Logging Symposium in London.

27 June 2018 – Steve Dsouza (Weatherford) gave a presentation on "Increasing Certainty in Formation Evaluation Utilizing Advanced Gas Analysis." After reviewing current mud logging technologies, the focus of this knowledge sharing was on advancements in hydrocarbon gas logging, including detection sensors and data processing and interpretation methodologies. Applications of mud logging, through integration with other available geological, petrophysical and engineering data, in enhanced formation evaluation such as fluid contact determination and fluid typing, were discussed extensively.

SAC June 2018 meeting. A certificate of appreciation for his technical presentation was presented to the speaker, Steve Dsouza (Weatherford), by Chapter officers.

24 July 2018 – The luncheon meetings was organized to formally introduce the new chapter president, Dr. Faisal Alenezi (Head of Saudi Aramco Gas Development Petrophysics Unit) and to bid farewell to a long-time outstanding SPWLA member, Steve Crary (Petrophysics Advisor, Schlumberger Saudi Arabia), prior his retirement and thank him for his unrelenting support to SPWLA in general and the local SAC in particular. Steve gave an exciting, emotional, and candid talk "Have I Learned Anything in 41 years?" reflecting on his four-decade long career, he started with an introduction of what it was like to be a field engineer in the "good old days," at the beginning of his career. Then the main talk was focused on four major challenges he faced and achievements he helped to make; (1) resistivity tool forward modeling, (2) carbon-oxygen logging in openhole completions, (3) deep azimuthal measurements for geosteering, and (4) NMR wettability. As lessons learned, Steve summarized that (1) you need to understand tool responses; the best way to gain this understanding is forward modeling, (2) be aware of your surroundings, (3) new innovative techniques require both hardware and software/interpretation innovation, and (4) there are still surprises out there. In conclusion, Steve provided the following advice (1) the oil industry is still a place to have a very interesting career, (2) we measure many things, but the trick is in the interpretation, (3) you need to be aware of unintended consequences of actions, and (4) the future holds a number of surprises for future petrophysicists; some good, some may not be so good, but all are interesting. The event was well attended.

SAC July 2018 meeting. Group photo with the speaker, Steve Cary, in the center.

08 August 2018 – A technical presentation was given by Chris McIlroy (Integrated Cased Hole Advisor –Halliburton) entitled "Challenges of Long-Term Reservoir Monitoring and a Brief Overview of Pulsed-Neutron Technologies Past, Present, and Future." The presentation covered the importance of the long-term monitoring of the formations and reservoir to maximizing hydrocarbon recovery, and minimizing water production. The different challenges that were faced were highlighted, including the ones from formation (lithology/porosity), completion structure, borehole fluids, changes in the formation fluids and reservoir properties, and static and dynamic well conditions. These complexities were discussed along with how pulsed-neutron plays a part in overcoming these challenges to long-term reservoir monitoring. In addition to that, conventional sigma and carbon-oxygen saturation methods were discussed along with more recent multidetector applications advantages for gas-saturation methods. Some case studies were presented along with additional unique applications of existing pulsed-neutron measurements. The event was well attended.

SAC August 2018 meeting: A token of appreciation was presented to the speaker Chris McIlroy (center) for his presentation.

Upcoming Events

Additional interested events are in the planning stages, including a workshop on well integrity to be held in September. Please stay tuned to our chapter website for details (spwla-

saudi.org).

CHINA PETROLEUM UNIVERSITY IN BEIJING STUDENT CHAPTER

Upcoming Events

15 September 2018 – The 2018 freshmen will be recruited to join our student chapter. In addition, the last president of the chapter, Li JunJian, will summarize the work of the past year, and the new supervisors of the chapter will also plan for the development of the chapter in the coming year.

FEDERAL UNIVERSITY OF RIO DE JANEIRO (UFRJ) STUDENT CHAPTER

Recent Events

25 June 2018 – Aristides Orlandi Neto from UFRJ taught a minicourse on "Basic Profiling"

17 July 2018 – Students attended the monthly SPWLA Brazil meeting at Petrobras.

August 2018 – Aristides Orlandi Neto complemented his earlier course in June with a practical minicourse on Techlog.

UFRJ Student Chapter June 2018. Aristides Orlandi Neto (right) minicourse instructor with the student member Anna Peres.

Upcoming Events

24–28 September 2018 – Second Petroleum Geology Week, held at the Federal University of Rio de Janeiro.

TEXAS TECH UNIVERSITY STUDENT CHAPTER

General News

The newly elected officers for the 2018/19 academic year are listed as following:

President	Daniel Owusu-Ansah
Vice-President	Ibe Ezisi
Treasurer	Elizabeth Reeder
Membership Chair	Rushil Pandya
Secretary	Garrett Payne
SORC Representative	Kristofer Aasen

Recent Events

31 August 2018 – Engineering Kick-off. This event was meant to expose our chapter to engineering majors who may not be familiar with us or are looking to join a petroleum engineering-based organization.

Upcoming Event

06 September 2018 –The first meeting of the semester will be held at 6 PM, Terry Fuller Petroleum Engineering Building Rm. 208, and will lay down the plans of our organization for the following months. The guest speaker will be James Hawkins (Vice-President of Subsurface Technology at Callon Petroleum Company).

08 September 2018 – This joint event hosted by SPE and SPWLA is a tailgate prior to the home football game against Lamar University. It will be held at 12 PM in the faculty parking lot behind the Terry Fuller Petroleum Engineering Building.

SPWLA SECOND BOARD OF DIRECTORS MEETING 2018–2019
Kinder Morgan Office, Houston, Texas
August 8, 2018

President Zhipeng Liu called the meeting to order at 8:00 am. In attendance: RD NA 2, Doug Patterson and Executive Director, Sharon Johnson, Attending remotely: President-Elect, Dr. Jesus Salazar, VP Technology, Jim Hemingway, VP Education, Katerina Yared, VP Finance, Secretary and Administration, Jennifer Market, VP Publications, Dr. Carlos Torres-Verdin, VP IT, Mehrnoosh Saneifar Regional Directors, NA 1, Adam Haecker, Latin America, Dr. Nadege Bize Forest, Asia Pacific/ Australia, Rick Aldred, Middle East/ Africa, Mark Ma.

A motion made by Doug Patterson to waive the reading of the minutes from the June 6th board meeting was seconded by Jennifer Market. All approved, and the motion passed.

A motion made by Mehrnoosh Saneifar to send member seniority certificates for 5,10,15,20, and 25+ year's of membership in recognition and appreciation for loyalty to SPWLA; to be sent to members in both printed mailed certificates and in a pdf file, was seconded by Adam Haecker. All approved, and the motion passed.

A motion made by Jennifer Market offering lifetime membership to members 60 years old or older with 15 consecutive years of active membership at the current price of six years of senior member rate (2018 x $50 = $300) starting in 2019, was seconded by Adam Haecker. 1-vote against, passed by majority.

A motion made by Adam Haecker to approve an annual budget of $500 per Student Chapter for general use for Chapter activities was seconded by Jennifer Market. Funds will be distributed upon request. Annual renewal required. All approved, and the motion passed.

A motion made Dr. Jesus Salazar to accept the VP Publication annual budget submitted by Dr. Carlos Torres-Verdin in the amount of $221,992.18 was seconded by Jennifer Market. All approved, and the motion passed.

A motion made by Jennifer Market to accept the Staff/ Operations/Facilities annual budget submitted by Sharon Johnson in the amount of $458,308.48 was seconded by Mehrnoosh Saneifar. All approved, and the motion passed.

A motion made by Jennifer Market to accept the IT annual budget submitted by Mehrnoosh Saneifar in the amount of $32,633.00 was seconded by Mehrnoosh Saneifar. All approved, and the motion passed.

A motion made by Jennifer Market to accept the VP Education annual budget submitted by Katerina Yared in the amount of $45,000 for Distinguished Lecture Program and $10,500 for Student Chapter support including paper contest was seconded by Doug Patterson. Travel funds discretionary allowance will be made by the VP Education to speakers who are available and willing to serve the chapters. All approved, and the motion passed.

A motion made by Jennifer Market to accept the Travel Program for Board of Directors annual budget submitted by Zhipeng Liu in the amount of $5,000 to assist board members with travel expenses to local Chapter meetings was seconded by Rick Aldred. The president can approve budgets up to $1,000 at his/her discretion. Any expenses over $1,000 require a board vote. All approved, and the motion passed.

Action Item: Sharon Johnson to create a form for the Student Chapter fund request.

Action Item: Sharon Johnson to design a poster template for SPWLA suitable for printing. Chapter resource.

Action Item: Sharon Johnson to create a template signup sheet for Chapter meetings to capture Associate Member information for the purpose of adding these members in the SPWLA international membership database.

Action Item: Mehrnoosh Saneifar to add a volunteer page on the SPWLA website. It will include current committee members from all levels and a link "Become a Volunteer"

A motion made by Doug Patterson to adjourn the meeting, was seconded by Mark Ma. All approved and the motion passed. Meeting adjourned 12:50 pm.

Respectively Submitted by
Sharon Johnson
Executive Director

Next BOD meeting: October 3, 2018 in Houston, Texas, at the Kinder Morgan Offices Downtown Houston

Ronke Aderibigbe
2018 Social Media Officer

One of the goals of SPWLA is to promote awareness and the value of petrophysics in the oil and gas industry and the scientific community. What better way to reach out and promote awareness other than through social media! According to a social media engagement statistics reported by Sprout Social, internet users spend roughly 1 in every 3 minutes on social media and messaging.

SPWLA International has a presence on LinkedIn, Facebook and Twitter. These media outlets have allowed us connect with petrophysicists, SPWLA members and others with shared interests in formation evaluation and petrophysics around the world.

Connect with us today, and we can help spread the word and promote SPWLA events (including local chapter events)! #SPWLAConnect

LinkedIn: **www.linkedin.com/in/spwla-socialmedia-454464105**
Facebook: **www.facebook.com/Society-of-Petrophysicists-and-Well-Log-Analysts-SPWLA-106794352733678/**
Twitter: **https://twitter.com/spwlaorg**

Welcome New Members — June 23, 2018 – August 22, 2018

Alenezi, Faisal Naif, Saudi Aramco, Saudi Arabia
Ameen, M.S., Saudi Aramco, Saudi Arabia
Boardman, Trey, Houston, TX, USA
Campbell, Luísa Figueiredo, UENF, Rio De Janeiro, Brazil
Cruz, Carolina Amorim Da, LENEP/UENF, Rio De Janeiro, Brazil
Earl, Kris, Gyrodata, Inc., Houston, TX, USA
Ely, Sam, Cabot Oil and Gas, Pittsburgh, PA, USA
Fasolo, Ricardo De Souza, Universidade Estadual Norte Fluminense
Ferreira, Danielle Franklin Gomes De Castro, UENF, Brazil
Filiptsova, Olga, Department of Water and Environmental Regulations, Perth, WA, Australia
Gaus, Garri, RWTH Aachen, Aachen, NRW, Germany
Gretskiy, Alexey, Schlumberger, Houston, TX, USA
Hamid, Abdul Rahman, EBN B.V., Utrecht, The Netherlands
Hutton, Kory Rene, Katalyst Data Management, Houston, TX, USA
Jerome, Thomas, GMDK Inc., Calgary, AB, Canada
Kanwar, Jyoti Swarup Singh, Colorado School of Mines, Denver, CO, USA
Kellam, Brad, IBall Instruments LLC, Oklahoma City, OK, USA
Khan, Aziz A., Calgary, AB, Canada
Kroc, Thomas, Fermilab, Batavia, IL, USA
Lakhan, Mukhtiar Ahmed, Pakistan Petroleum Limited, Abu Dhabi, United Arab Emirates
McLean, Jennifer Kim, Paradigm, Houston, TX, USA
Murtaugh, John Philip, Endeavor Energy Resources, Midland, TX, USA
Murugesu, Manju Pharkavi, Colorado School of Mines, Golden, CO, USA
Oliveira, Lucas Isaac Vieira, UENF Rio De Janerio, Brazil
Pasciak,Nicholas, Apache Corporation, San Antonio, TX, USA
Ramiro-Ramirez, Sebastian, University of Texas at Austin, Austin, TX, USA
Sanmanee, Sirichai, PTT Exploration and Production Co Ltd (PCL), Bangkok, Thailand
Seth, Puneet, University of Texas at Austin, Austin, TX, USA
Soares, Tamires Dos Santos, UENF, Rio De Janeiro, Brazil
Valon, Vinicius Fani Souza, Universidade Federal Do Norte Fluminense – LENEP, Rio De Janeiro, Brazil
Vence, Javier, ECP, Bogota, Colombia
Wierenga, Steve, That Wireline Guy, Okotoks, AB, Canada
Zastoupil, Brett, Kinder Morgan, Houston, TX, USA

Acoustics SIG Announcement

The Acoustics SIG has developed a list of acoustics-related authors and abstracts who are available as guest speakers for SPWLA chapter meetings and events. For a copy of the list please contact the SIG Secretary (Matt Blyth) via mblyth@slb.com.