2nd Edition 2016

geoLOGIC NEWS

A publication of Subsurface Consultants & Associates, LLC

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in this issue:

SCA welcomes **Susan Howes** as Vice President of Engineering!
See page 8...

President's Corner

A message from our President, Hal Miller:

The Case for Hiring Consultant Mentors

In late 2013, SCA conducted an online survey entitled "Millennials in the Energy Industry: Understanding the Generation Gap" (See our website for summary). The objective of the survey was to obtain insight into developing and retaining the Millennial generation of energy professionals. A key survey topic was the role and availability of mentors.

Responses were broken down by generational categories: the Baby Boomer Generation (born from 1946-1964), Generation X (1965-1981), and Millennials (1982-1993). As might be expected, Millennials reported the highest percentage of access to professional mentors in their current jobs at 69%. Of those who had access to mentors 78% considered mentoring to be significant to their professional development.

At the time of the survey, nearly 60% of the respondents in the Baby Boomer Generation (those providing most of the mentoring) projected that within the next five years they would be retired or engaged in independent consulting. The oil price crash during the intervening 2½ years has of course accelerated the imminent loss of mentoring capacity at an industry scale through incentivized retirements and layoffs. Those few remaining internal mentors have full time job expectations and little capacity to take on even more mentoring duties.

We at SCA have talked to many managers who are deeply concerned about the dramatic and abrupt loss of experience and skills in their organizations, especially in an environment where early career professionals are rapidly taking on responsibilities formerly handled by now retired senior staff. Even a modest increase in activity resulting from the inevitable rebalancing of supply and demand will regenerate the need for seasoned oil finders with critical skills and geographic experience. Realistically, having just finished major staff reductions companies are not going to move quickly into employee hiring mode.

A potential solution is the hiring of consultant mentors to address specific skill or experience gaps while fulfilling mentoring roles. Conveniently, many late career geoscientists and engineers are at a stage in their careers where a consulting mentoring role is very attractive and satisfying. It is also worth noting that consultants get paid whether they are interpreting or mentoring, and they have no performance review responsibilities so mentorees may be more willing to ask them for help. There is no substitute for 30 or 40 years of experience, and no reason to reinvent the wheel.

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Recommended Courses Related to Habit 9

Applied Subsurface Geological Mapping (ASGM)

This is one of the most demanded subsurface mapping courses in the world. From the newly graduated geoscientist or engineer to the seasoned professional, this course provides the applied, hands-on knowledge required to generate sound subsurface maps. Participants of this course will receive the Applied Subsurface Geological Mapping with Structural Methods 2nd Edition textbook (2003) and a lab manual with excercises. Solutions are provided throughout the course. This course covers both fundamental and advanced methods of subsurface mapping that have been used by the most proficient exploration and development geoscientists in the industry, as well as an introduction to some of the more recent advances in interpretation.

Aug 1-5, 2016	Dallas, TX
Aug 1-5, 2016	Denver, CO
Oct 10-14, 2016	Midland, TX
Oct 24-28, 2016	Anchorage, AK
Nov 21-25, 2016	KL, Malaysia
Nov 28 - Dec 2, 2016	Calgary, Canada
Dec 5-9, 2016	Houston, TX

QC Techniques for Reviewing Prospects & Acquisitions

This unique 3-day course addresses the need for managers to obtain a systematic approach for quickly screening interpretations, maps, prospects, and potential resources or reserves and identifying fundamental interpretation, mapping, and estimating errors. The course begins with a review of examples of interpretation and mapping errors that led to poorly located wells that proved to be uneconomic or dry, as well as inaccurate reserves or resources estimates. The participants are challenged with a series of real exploration and development prospects and maps for their evaluation.

Nov 27-29, 2016	KL, Malasysia

For a complete list of the 2016 public course schedule including course descriptions and target audiences, please visit our website at:

www.scacompanies.com

Exploring the Ten Habits: Habit 9

Successful oil finders document their work.

By Bob Shoup

Imagine yourself sitting at your workstation interpreting away when someone comes into your office and says, “Hi, I am from the SEC and I am here to audit you”. Here is some advice. Stifle your instinct to panic, introduce yourself and invite him or her to take a seat. Once the formalities are over, provide the auditor with all of the documentation you have for the asset they are auditing. We live in an audit friendly world today (yes, I know that is an oxymoron, there is no such thing as a friendly audit), so the chances of you being the subject of an audit have never been higher. Wouldn’t it be easier to hand your thoroughly documented work to the auditor than to spend hours or maybe days re-creating your work to justify your reserve estimates?

Don’t think you will ever be audited? Then imagine this scenario. You are presenting a prospect to your company’s senior vice president. The key reservoir for the prospect has been faulted out of the well closest to the prospect. Your correlation of that well to an unfaulted well indicates that the fault has 200 feet of missing section. Yet on the map you have shown only 140 of vertical separation. The vice president asks you why you have 200 feet of missing section in the well, and only 140 feet of vertical separation on the map, and you cannot explain it to him. As you slink back to your office, you remember that the 200 feet of missing section was determined in a deviated well, and the vertical separation represents the true vertical thickness (TVT) of that missing section. Too late! You have already lost credibility with the vice president and with your boss as well. If only you had fully documented that fault information on your map or your wells.

Let’s fast forward a few years. You have rebuilt your credibility and are presenting a regional map of a play that has several prospects in it. The play area includes a dry hole drilled by your company many years ago. The senior vice president asks why the company drilled that well since the new regional maps indicate that there is no structural trap at that location. Although that was one of the first projects you worked, that was years ago, and you can’t remember any of the details. As you once again slink back to your office you remember that the prospect was drilled before the company acquired 3D seismic over the region, belatedly verifying the lack of a trap at that old location. Too late, your credibility has taken another hit with the vice president.

All of these scenarios have happened. And all of them could have had significantly different results had the interpreters taken a few minutes and documented their work. Admittedly, documentation is one of my least favorite tasks. I would much rather correlate logs or seismic, or make maps than fill out spreadsheets. But, the time it takes to properly document your project can pay big dividends; you can more efficiently execute your project and evaluate your prospects and developments with proper documentation. You can also explain things to your senior vice president and keep your credibility.

The Practice of Seismic Stratigraphy in Deepwater Settings

By Brad Prather

Catuneanu et al. (2009a) and his 27 co-authors make the case for a standardized sequence stratigraphic methodology, including definition of concepts, stratigraphic units, bounding surfaces and workflow. Despite this and other calls for standardization over the years there remains no generally accepted single approach to sequence stratigraphic analysis. In fact publication of the plea from Catuneanu only engendered continuing debate (Catuneanu et al., 2009b; Helland-Hansen, 2009; Neal & Abreu, 2009; Bhattacharya, 2011; Henriksen et al., 2011). Catuneanu et al. (2009a) suggest that the process of standardization is hampered mainly because consensus needs to be reached between 'schools' that promote rather different approaches (or models) with respect to how the sequence stratigraphic method should be applied to the rock record (Catuneanu et al., 2009a). The lack of consensus requires practicing geologists to become stratigraphic polyglots in that they need to both understand the conceptual basis for the differences but also able to speak the various languages in order to communicate among their peers.

A surprising consensus from the 2014 William Smith Conference is that the utility of the sequence stratigraphy methodology is not really in question. The more theoretical aspects for correlating and understanding the evolution of stratigraphic successions and classification of stratal architecture into accommodation controlled systems tracts, as presumed by their naming convention, are however. These more theoretical aspects have become especially problematic, as there is now strong evidence that stratal geometry on basin margins are most likely a consequence of multiple controls, not just variations in accommodation, and process interpretations will require an understanding of how multiple different controls generate similar geometries (Burgess & Prince, 2015).

Neal and Abreu (2009) remind us that the propose a stratigraphic framework for the hierarchy of sedimentary units observed in stratigraphic data that is based entirely on the geometric relationship of the strata will allow an interpreter to accurately categorize observations, provide a basis for predictions away from control points, and develop a framework that allows revisions as higher-resolution data become available. Embry (2009) present a series articles on the practical aspects of sequence stratigraphy that emphasizes the application to the discipline of stratigraphy rather than dwelling on theoretical models. Embry (2009) makes the case that sequence stratigraphy is best viewed as a separate stratigraphic discipline rather than some all-encompassing discipline which integrates data from all sources.

But, there is another way to view practicality in the role of the sequence stratigraphic methodology as used in the industry. Here we find emphasis on using the tool to quantify risk and uncertainty for both hydrocarbon exploration and development. To that end industry sequence stratigraphers, really they are best described as seismic stratigraphers, as they are asked to represent on maps and cross sections, stratigraphic interpretations from the integration of well and seismic data (2D and/or 3D).

For exploration geologists the primary map for this purpose is a Gross Depositional Environment (GDE) map (Figure 1). GDE maps are the tools for reservoir, source and seal description as part of basin-play evaluation. A GDE map is a summary description of the (regional) distribution of depositional environments for a given chronostratigraphic interval

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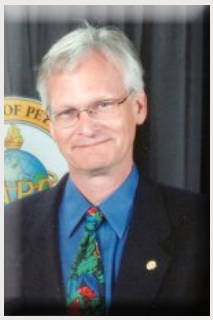
Featured Instructor: Brad Prather



Mr. Prather graduated from the University of Kansas in 1979 with a BSc in geology. Afterwards he attended the University of New Orleans to pursue a Master's Degree in Earth Sciences, graduating in 1981. Mr. Prather then joined the Onshore Division of Shell Oil Company, New Orleans, in 1981 as a summer intern and became a full-time Exploration Geologist in January of 1982. His exploration career began by prospecting for oil and gas in onshore Mississippi, Alabama and Florida. Over time he moved to offshore, starting in the US Atlantic margin, then to MAFLA (the offshore of Mississippi, Alabama, and Florida) and shelf provinces of Louisiana and Texas, and eventually ended up in deep-water Gulf of Mexico where he served as Division Geologist. In 1995, he left New Orleans for a 5-year assignment in The Hague, The Netherlands, focusing on global deep-water plays. This work eventually led to creation of Shell's Turbidites Research Team (TRT) which he led until 2008 from offices in Rijswijk, The Netherlands and Houston, Texas. He returned to exploration in the Americas in 2008 as a Geological Advisor and eventually became Regional Chief Exploration Geoscientist in 2009. Upon retirement from Shell in 2014, he joined the University of Kansas as an Adjunct Professor where he teaches courses focused on seismic stratigraphy, petroleum systems, and sedimentology.

He is an Associate Editor for the AAPG Bulletin, serves on both the SEPM and AAPG Research committees, and is a referee for many scientific journals. He was a Shore-Based Scientist for IODP Leg 308, which cored the Brazos-Trinity Basin IV in the Gulf of Mexico. Prather currently is the Chairman of the Executive Committee of Geology Associates Advisory Board to the Department of Geology at the University of Kansas.

Prather is the recipient of Robert R. Berg Award for Outstanding Research (2009), Erasmus Haworth Most Distinguished Alumni Honors in Geology (2006), AAPG Distinguished Lecturer (2000-2001), Jules Braunstein Best Poster Award (2000), J. C. "CAM" Sproule Memorial Best Paper Awards (1993 and 1994) and W. A. Tarr Leadership Award (1979).

Upcoming Training Course
Taught by Brad Prather:

Integrated Deepwater Depositional and Petroleum Systems
Nov 7-10, 2016 Houston, TX

(Mitchener et al., 1992). There are no generally accepted terms for gross depositional environments (Prather et al., 2016). Usage varies considerably among workers however; workers tend towards pragmatism in their choice of terminology (e.g., Mitchener et al., 1992; Jennette et al., 2003; Galloway & Andrew, 2008; Luheshi et al., 2010).

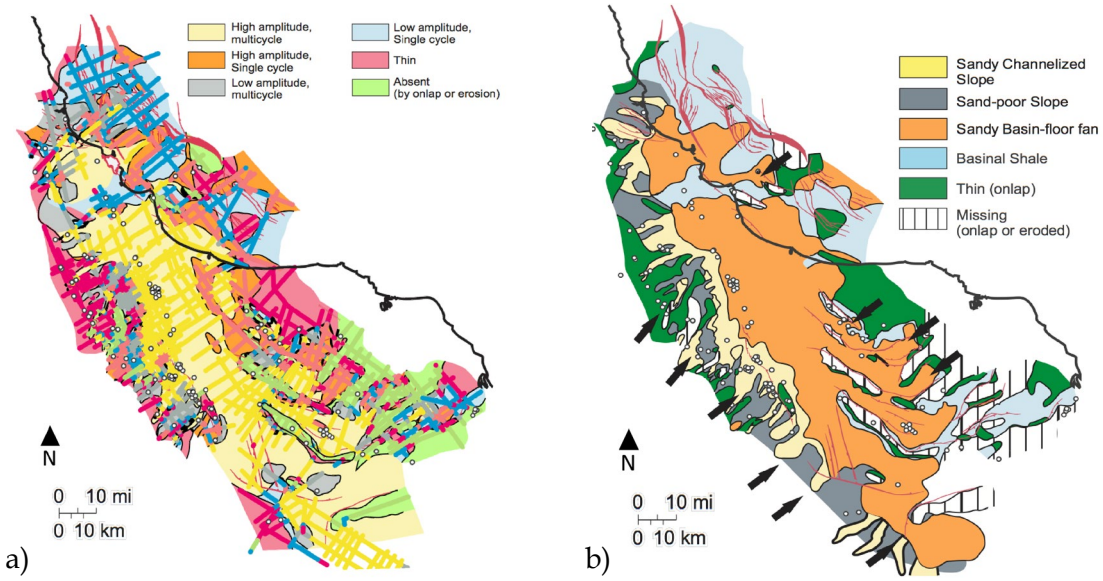


Figure 1. a) Seismic facies ribbon map and b) GDE map (Jennette *et al.*, 2002 Fig. 6)

The GDE mapping process begins with examination of the seismic data to determine whether the seismic data are processed to produce trace integrated or reflection coefficient seismic volumes, including knowing the polarity, phase, frequency, processing schemes, etc. Although the objective of mapping is construction of a regional stratigraphic framework, typically a trunk line is selected from the data set for detailed interpretation whether from a 2D grid or 3D volume. Post and tie either time-converted key well logs on the key line if the seismic is not depth converted or depth logs if the data are depth converted. Assuring that well data are properly integrated with seismic can be very involved and beyond the scope of this paper, so we'll assume this has been adequately addressed in order to proceed with the interpretation process.

1. Tie wells to seismic sections
2. Describe surfaces and stratigraphic architecture
a. Interpret faults and place fault traces on line of section
b. Define chronostratigraphic units
3. Correlate the surfaces through wells and seismic
4. Use the surfaces to map the seismic stratigraphic units into GDE scale maps
5. Interpret GDE from planform and stratigraphic architecture as appropriate
6. Interpret depositional processes
7. Select appropriate analogues based on process understanding implied by the GDE maps, surfaces and stratigraphic architecture
8. Quantify risk and uncertainties based on local GDE data and analogue

Interpretation of the trunk line begins with identification and annotation of faults on the line of section. This step is followed by identification of several regionally continuous seismic events. These seismic events are typically single-loop and highly continuous. Where there are no adequate seismic events, "generic" surfaces that are essentially surfaces correlative to some form of sequence boundary are identified. Correlative surfaces must adjoin each other forming one continuous horizon (cf., Embry, 2009). In these cases correlation of these generic surfaces is the only way of extending a "sequence boundary" over all or most of a basin. Correlative surfaces can be unconformities, diastems. or conformities and they preferably have low diachroneity or are time barriers (cf., Embry, 2009). The age of these events and surfaces can be estimated using key wells, usually with biostratigraphic dates in order to establish a chronostratigraphic framework suitable for purposes of basin modeling, structure mapping and

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GDE mapping. At this point correlation of the regional events and surfaces throughout the seismic data grid or volume can be conducted independent of more detailed seismic-stratigraphic interpretations to follow.

Seismic-stratigraphic interpretation begins with identification and annotation of event terminations on the trunk line. The event terminations help indicate the position of "surfaces" of truncation onlap, toplap and baselap. Annotation of significant conformities or disconformities follows, where truncation or baselap surfaces pass laterally into concordant strata, and no seismic evidence of a hiatus exists. Significant conformities are stratal surfaces that can be traced laterally, usually downdip from local truncation surfaces into concordant strata where there is no seismic evidence of erosion, non-deposition, or a significant hiatus. Significant disconformities are surfaces traced laterally, usually updip from surfaces of baselap into concordant strata.

At this point one can either classify seismic facies using any one of a number of descriptive schemes (Sangree et al., 1978; Feeley et al., 1985; Mitchum et al., 1991; Pacht et al., 1991; Radovich et al., 1991; Vail & Wornardt, 1991; Liu & Watkins, 1992; Wagner et al., 1992; Prather et al., 1998; Goulding et al., 2000; Shanley et al., 2000; Jennette et al., 2003) or systems tracts (Posamentier et al., 1988; Haq, 1991; Neal & Abreu, 2009). Mapping seismic facies units or systems tracts throughout the region creates either a 2D ribbon map (Figure 1a) or a 3D horizon conformable attribute extraction (Figure 2a).

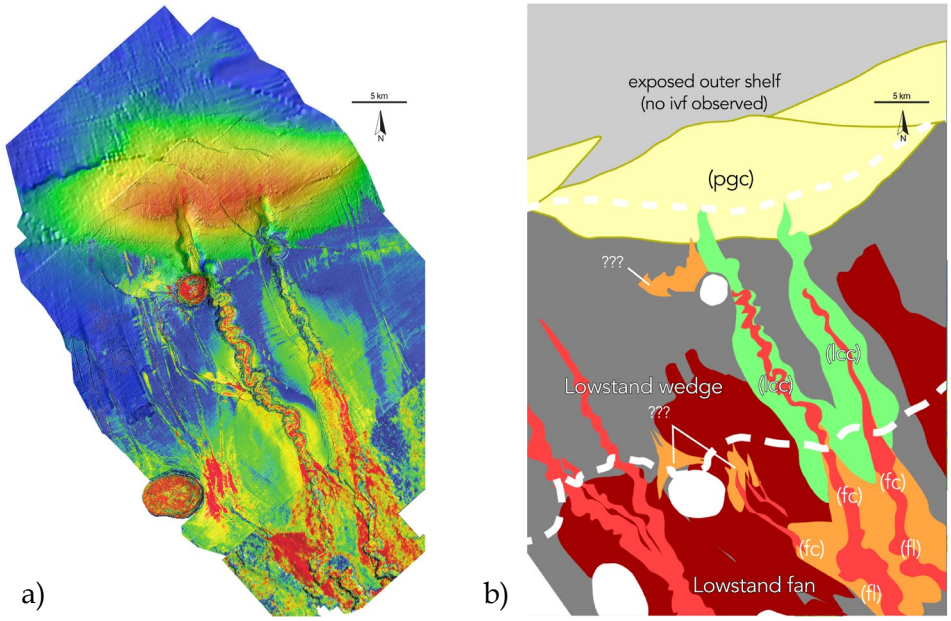


Figure 2. a) 3D seismic attribute map (modified from Sylvester *et al.*, 2012). b) Systems tracts map (pgc = prograding complex, lcc = leveed channel complex, fc = fan channels, fl = fan lobes).

Seismic facies planform and cross-sectional geometries form the basis for GDE interpretations (e.g., Jennette et al., 2002; Prather et al., 2016). The relationship between planform geometry and GDE is largely based on comparison to well understood shallow analogues through the application of a sub-discipline of geology referred to recently by Posamentier et al. (2007) as seismic geomorphology (Figure 1b).The same can be attempted with maps of systems tracts, as systems tracts can be thought of as seismic facies but are more problematic in their classification as systems are represented as diachronous units (see Haq et al., 1988 Fig. 10), never the less systems tracts maps can be constructed (Figure 2b).

The seismic stratigrapher is also responsible for presenting a process-based understanding of maps, cross sections and static reservoir models through the integration of sedimentology, in order to describe the observed arrangement of facies. This step provides the conceptual basis for identifying analog data sets in order to quantify risk, construct probability distributions for use in probability volumetric calculations and benchmarking reservoir simulations, and is a necessary step to add credibility of the interpretation product and serves as a means to judge validity of the interpretation when making business decisions.

For article references, please consult the linked PDF.

Courses Taught by Brad Prather

The Practice of Seismic Stratigraphy in Deepwater Settings

Play-based exploration as used in the oil industry relies on developing a thorough understanding of the evolution of key sedimentary sequences through time in the form of Gross Depositional Environment (GDE) maps. This course provides techniques for making GDE maps of deepwater stratigraphy, and the language concepts needed to articulate a basin-to-prospect-scale, deepwater depositional models needed for the quantification of prospect risk and uncertainty. The course integrates slope depositional process understanding with sequence stratigraphy, and seismic facies analysis used in the construction of GDE maps.

Learning outcomes:

- Understand the role GDE maps play in frontier exploration
- Achieve a general understanding of deepwater depositional models
- Learn how to classify slope systems
- Practice classification and mapping of seismic facies, interpreting environments of deposition, and developing depositional models
- Apply sequence stratigraphic concepts in an analysis of deepwater systems
- Strengthen confidence in using depositional models to assemble appropriate analogs to benchmark distributions used as part of play and prospect evaluation process

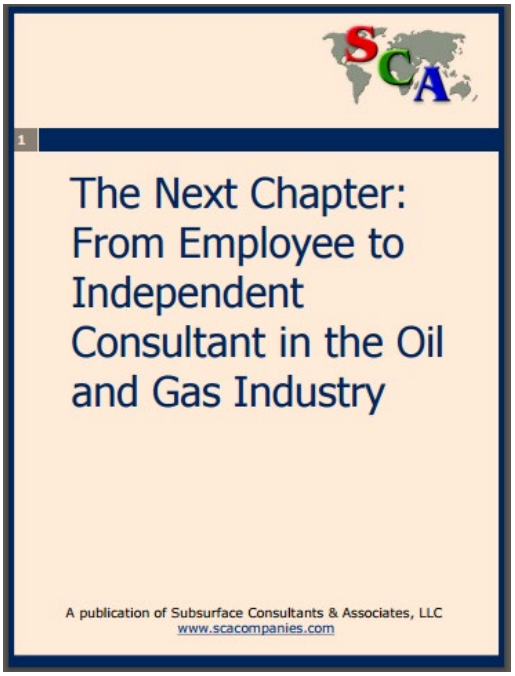
Integrated Deepwater Depositional and Petroleum Systems

This course provides the knowledge needed to make Gross Depositional Environment (GDE) maps of deepwater stratigraphy and their use in making Common Risk Segment (CRS) maps, leading eventually to the development of a final Yet-to-Find (YTF) analysis of a deepwater play segment. The course is designed around a well-established industry approach (play-based exploration). Class exercises are focused on the objective of identifying and assessing a portfolio of prospects from an existing deepwater play.

Learning outcomes:

- Hands-on experience building and using gross depositional environment (GDE) maps to assign risks to a portfolio of prospects
- Understand the methodologies for construction of Common Risk Segment (CRS) maps
- Experience assembling a portfolio of deepwater prospects
- Gain an appreciation for the factors that control the distribution of reservoir, seal, and source rocks
- Learn how to risk a prospect inventory
- Risk reservoir, seal, charge, and structure of an individual prospect

The Next Chapter: From Employee to Independent Consultant in the Oil and Gas Industry



Whether you've recently transitioned out of a full-time position or have chosen to retire and want to stay professionally engaged, a career in consulting can offer greater flexibility, diverse project opportunities, and attractive compensation.

Our eBrochure provides a comprehensive look at what it means to be an independent consultant in the oil and gas industry and how to be successful doing so. The information covered in the following chapters is meant to serve as a guiding tool for reference throughout the process:

Chapter 1: Why Become a Consultant?
Chapter 2: Self-Managing
Chapter 3: Understanding Independent Contractor Status
Chapter 4: Financial Planning, Taxes, and Legal Considerations
Chapter 5: Navigating the Path to Consulting
Chapter 6: Strategies for Success on the Job
Chapter 7: Advantages of Working with a Consulting Company

Click this link to access the full document from SCAs website.

Would You Invest $4,000 to Save $4,000,000?

By Bob Shoup

We often think of Return on Investment when we manage our portfolio. We tend to invest where we have the highest expectation of making money. We rarely, if ever, invest money to save money. Hence the question: would you invest $4,000 to save $4,000,000? I think you will agree that an outlay of $4,000 would be a good investment if we knew it would prevent a $4,000,000 loss.

So what $4,000 investment can you make to save $4,000,000? A class! Not just any class of course, but a class that helps your staff avoid drilling a dry hole. Many dry holes have been drilled on prospects that were improperly mapped; maps that looked acceptable but were in fact geologically, and often geometrically impossible.

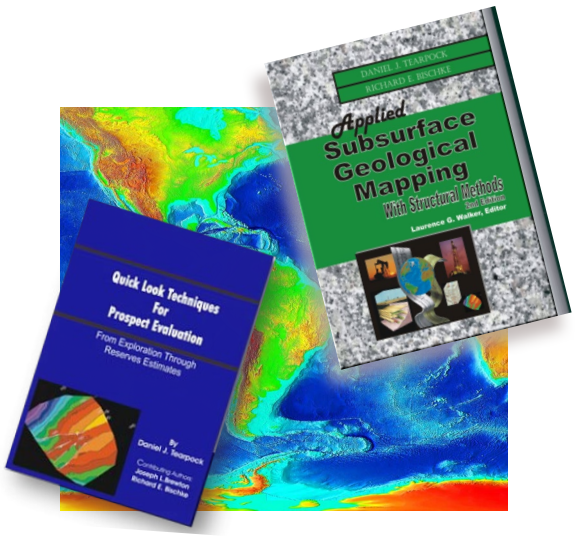
As discussed in the President's Column, we are in the midst of the "crew change". The millennial generation who are taking over the roles of generating and evaluating prospects are enthusiastic and bright, and almost universally rely on powerful new workstation tools to make their interpretations and maps. In doing so, many have gotten away from fully understanding the geology that goes into defining a prospect; instead relying heavily on workstation mapping algorithms to guide their contouring. Moreover, early career professionals oftentimes lack the skills and experience to critically review and correct the maps coming out of their workstations. The result for our industry will be an increasing number of dry holes; dry holes that can be easily avoided with an investment of approximately $4,000.

SCA's signature five-day class Applied Subsurface Geological Mapping will teach your staff the methods, techniques, and skills they need to make more accurate and geologically valid subsurface interpretations and maps, and start avoiding those dry holes. The cost for attending this class in SCA's Houston training facility is $3,350.

We also offer a three-day class entitled Quality Control Techniques for Reviewing Prospects and Acquisitions. This class will help your staff, including peer review teams, front line supervisors and managers, review prospects and acquisitions to ensure that they have been properly mapped and avoid investing in over-estimated reserves or dry-holes-in-waiting. The cost for attending this class in SCA's Houston training facility is $2,575.

Upcoming Training Courses in 2016

Aug	08/01-05/16	Applied Subsurface Geological Mapping (Dallas)
	08/01-05/16	Applied Subsurface Geological Mapping (Denver)
	08/07-13/16	The Book Cliffs of Utah - Field Trip
	08/15-16/16	Economic Evaluation of Petroleum Opportunities
	08/29/16	Basics of the Petroleum Industry
Sept	08/30-09/02/16	Structural Styles in Petroleum Exploration and Production
	09/03-04/16	Structural & Sequence Stratigraphy Field Course (Hill Country)
	09/06-09/16	Practical Interpretation of Open Hole Logs
	09/12-16/16	Practical Seismic Exploration & Development
	09/19-23/16	Sequence Stratigraphy Applied to O&G Exploration
	09/26-30/16	Basic Petroleum Engineering Practices
	09/26-30/16	Applied Subsurface Geological Mapping
Oct	10/10-12/16	Refrac Candidate Selection, Execution, & Performance Evaluation
	10/10-14/16	Applied Subsurface Geological Mapping (Midland)
	10/17-19/16	Advanced Drilling Technologies
	10/17-21/16	Cased Hole and Production Log Evaluation
	10/24-26/16	Managed Pressure Drilling/Underbalanced Drilling (MPD/UBD)
	10/24-28/16	Applied Subsurface Geological Mapping (Anchorage)



These SCA textbooks are foundation works for accepted practice in oil & gas exploration and development. Taught and sold around the world!

Reserve your seat today!

For full course listings, go to www.scacompanies.com

About SCA

Subsurface Consultants & Associates, LLC provides upstream consultancy and training to professionals in the oil and gas industry. Founded in 1988 by Daniel J. Tearpock, SCA's four primary services are geoscience and engineering consulting, upstream projects and studies, training services, and direct-hire recruitment.

SCA has trained over 26,000 geoscientists and engineers and has evaluated over 5,000 prospects worldwide in over 50 countries. SCA's staff has found and/or developed over 6 billion barrels of oil equivalent around the world for our clients.

We have been accredited as an Authorized Provider by the International Association for Continuing Education and Training (IACET), authorizing SCA to offer IACET CEUs for its programs that qualify under the ANSI/IACET Standard. Professionals who are required to maintain their state, federal or society licensing, registration or certification can fulfill their requirements by attending SCA training courses.

The People & Activities of SCA

Susan Howes, VP of Engineering

SCA is proud to welcome Susan Howes to the SCA team. She will be officially starting as Vice President of Engineering in August. Susan held previous roles as a Reservoir Management Consultant at Chevron and as Learning and Organizational Development Manager at Anadarko. Howes has coauthored several papers and articles on the topics of uncertainty management, risk management, and talent management for SPE conferences and publications. Howes is chair of the SPE Soft Skills Committee, previously served as SPE Regional Director for Gulf Coast North America, is a recipient of the SPE DeGolyer Distinguished Service Medal and is an SPE Distinguished Member. She holds a BS degree in petroleum engineering from the University of Texas.

SCA participated in OTC 2016 as part of the "OTC Reaching Out and Reaching Up – Networking in the Downturn" event. Our President Hal Miller (pictured right, center) was one of the event speakers and, alongside Director, Business Development Matt Nowak and Sr. Recruiter Mark Connor, also facilitated roundtable discussions with event attendees focused on the process of becoming an independent contractor.

Offshore Technology Conference 2016

Annual AAPG 2016 Convention & Exhibition

SCA was in attendance at the AAPG 2016 Annual Convention & Exhibition in Calgary. Pictured to the left at our booth are Mary Atchison, VP of Training, and Bob Shoup, longtime SCA instructor and consultant. Bob recently completed serving as the Chair of AAPG's House of Delegates. As Chair of the House, he also served on the AAPG Executive Committee. His term culminated at the annual House of Delegates meeting in Calgary, as pictured right.