HGS Bulletin
Houston Geological Society
Volume 56, Number 8
April 2014

Election Issue

HGS Night at the Paleontology Museum Social Event for the 2014 AAPG Convention

Page 4

Snowball Earth: Frozen Oceans and Greenhouse Gases

Page 7

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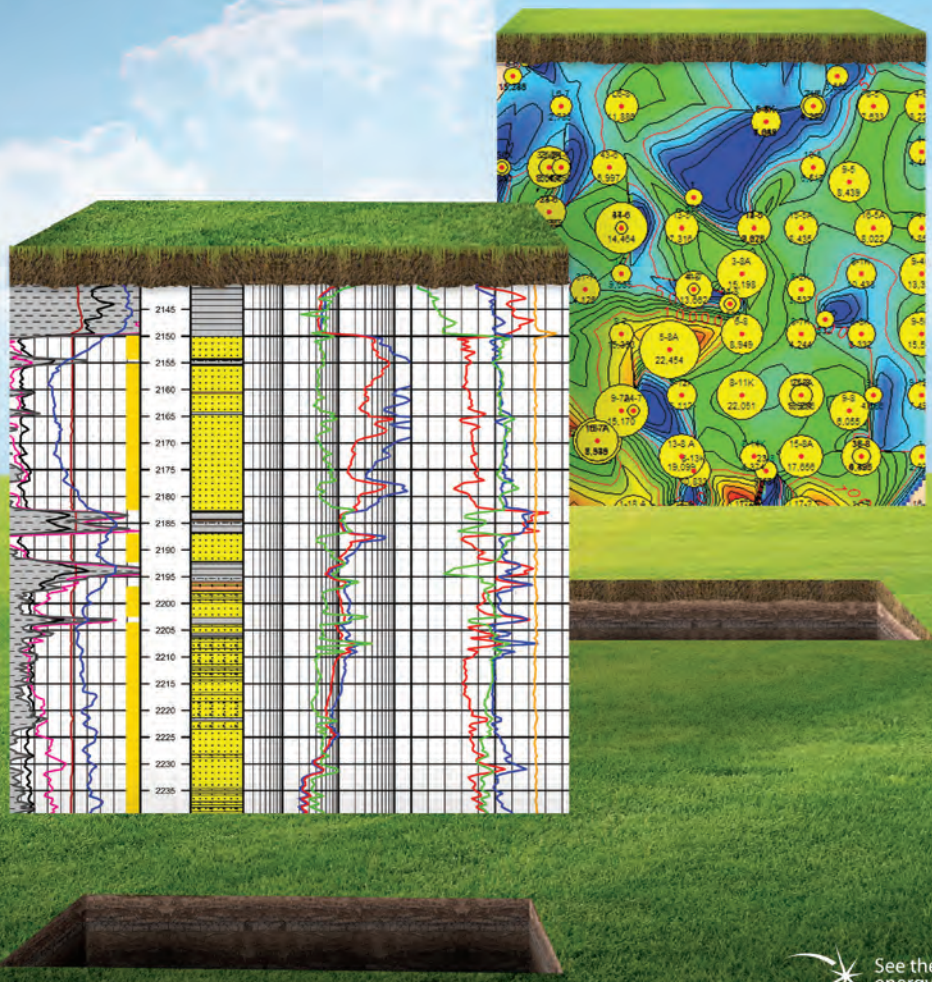

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The Bulletin
Houston Geological Society

Volume 56, Number 8 April 2014

In Every Issue

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Technical Meetings

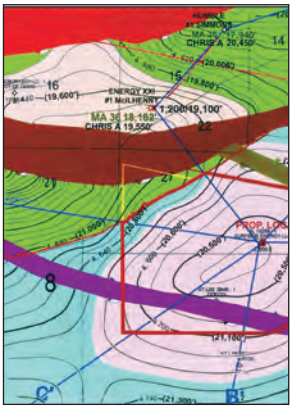
Other Features

page 4

Vote in the HGS election.

page 22

page 33



page 51

About the Cover: Reconstruction of a fossil *Smilodon*, or saber-toothed cat, of the extinct genus of *machairodont felid*. *Smilodon* lived in North America during the Pleistocene epoch between approximately 2.5 million to 10,000 years ago. *Smilodon*, more robustly built than any modern cat, with particularly well-developed forelimbs and exceptionally long upper canine teeth, was a specialized hunter of large herbivores like bison and camels. *Photograph courtesy of the Houston Museum of Natural Science.*

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AAPG 2014 Houston Convention Special Event

HGS "Night at the Paleontology Museum"

Featuring Dr. Robert T. Bakker

Tuesday, April 8, 2014
6:30pm – 10:30pm

Tickets Available at www.hgs.org

Morian Hall of Paleontology, Houston Museum of Natural Science

$65 per person for adults
$35 per person for students

Tickets sold online at the AAPG convention website www.aapg.org/houston2014/

Admission includes multi-course buffet dinner and IMAX theatre talk. Cash bar.

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Free museum garage parking for registrants driving personal cars.

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Join the Houston Geological Society on Tuesday, April 8, and experience the world-class Houston Museum of Natural Science Morian Hall of Paleontology featuring over sixty huge fossil displays and 30 action-posed dinosaurs. Inspect a real T. rex skeleton featuring the best preserved and most complete hands and feet of any T. rex ever found! See a uniquely well-preserved Triceratops — "mummified" with preserved skin, plus fossil dinosaur eggs and a "prehistoric safari" that includes the grand saga of human evolution! There will be guided tours by volunteer experts inside the exhibit hall, plus time to meet Dr. Bakker and ask questions about the dinosaurs.

Your ticket buys you a delicious buffet dinner, drinks and amazement, as you sit next to the huge dinosaur, reptile and fossil displays. The HGS encourages AAPG convention registrants to bring spouses and young guests to this social event. This night at the museum will include a fascinating talk by Dr. Robert T. Bakker, ground breaking science author ("The Dinosaur Heresies") and authority on dinosaur evolution. Dr. Bakker is a world-famous lecturer, consultant and advisor to the movie Jurassic Park.

This event is sure to sell-out and space is limited to the first 400 people. Tickets for AAPG convention participants and guests will be sold online using the AAPG ACE convention website at www.aapg.org/houston2014/.

Barry Katz

bjkatz.hgs@gmail.com

It is Now Time to Vote

The April issue of the *Bulletin* announces the candidates for the HGS officers and Board of Directors for 2014-15 and members of the AAPG House of Delegates for 2014-17. [**Editor's Note**: Candidate profiles for the AAPG House of Delegates will appear in the May issue of the HGS *Bulletin*.] First let me thank each of the candidates for stepping forward to take on their respective tasks, which include guiding our organization forward and representing the Houston Geologic Society as part of AAPG's deliberative body. I now ask that each of you take a few minutes and read the biographical material and reasons that each candidate has provided to explain their decision to stand for office, followed by the important act of submitting your vote. Your participation in the voting process remains an important part of the success and future of both organizations.

Over the years, the HGS has grown significantly. The Society's annual budget now exceeds $1,000,000. The organization has expanded its office space and now has three full-time employees. From September through June, there may be as many as six monthly meetings organized by the Society. HGS continues to print a hard-copy magazine style monthly *Bulletin*. In addition, HGS now organizes at least two conferences each year, with international participation, as well as a number of short courses. The Society continues to be active in guaranteeing the future of our science and profession by supporting two funds which grant undergraduate and graduate scholarships. We also continue to support the Science and Engineering Fair of Houston, as well as Earth Science Week each year, and have approved a contribution toward an endowment that will guarantee long-term survival of the Science Fair. The Society also maintains several members' social programs, such as the Tennis, Golf, and Skeet tournaments, as well as Guest Night.

As HGS moves forward, it has a number of key challenges. As President, I recognize that there are at least two major challenges that the incoming Boards will need to address over the next few years. The first is membership growth and the need to shift the demographics of the Society. Earlier this year, we had a very successful drive to recover lost members. In 2013, the change in the Society's website introduced a number of problems in accepting payments. Members became frustrated and did not renew. The website problem, which has been corrected, resulted in a "loss" of more than 2000 active members. The good news is that more than half have returned. The bad news is that we still lost a significant number of our members. New member applications remain steady each month, but could be significantly greater, especially as the "Great Crew Change" begins to increase its pace and the need increases for members that are new to our profession.

As HGS moves forward, it has a number of key challenges. As President, I recognize that there are at least two major challenges that the incoming Boards will need to address over the next few years.

Future Boards will need to take on the challenge of finding a way to entice the young professional to join HGS. This will require a fresh approach to this challenge that has persisted for several years. The second challenge is a matter of ensuring that the volunteer pool is renewed. Many of our committees have been chaired and staffed by the same volunteers for multiple years. Although they continue to do an exceptional job, we cannot expect that this will continue indefinitely. Ensuring succession plans for committee chairs and committee membership will be high on the list of the 2014-15 Board's work. They will need to ensure that new people volunteer and that they are successfully mentored, making sure that the job responsibilities and work plans for each committee and position are documented. If HGS lacks an informed volunteer pool to run an activity, that program may disappear. Your vote for the HGS officers is the first step in ensuring that these programs move forward and that the key challenges for the Society are overcome.

The new members of the AAPG House of Delegates (HOD) will also have some key issues **From The President** *continued on page 9*

Michael F. Forlenza, P.G.
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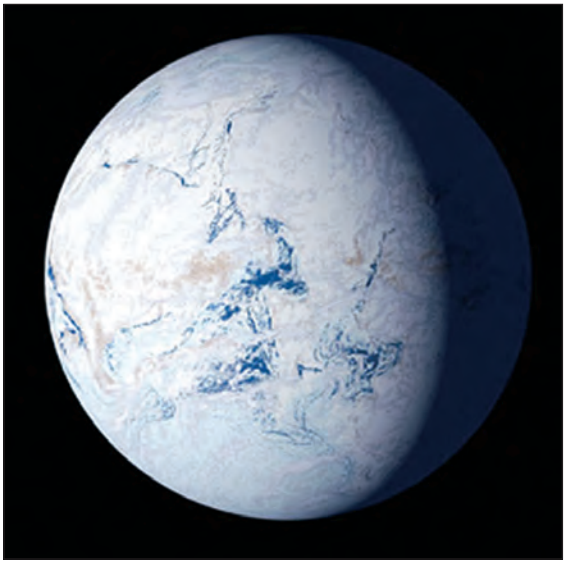
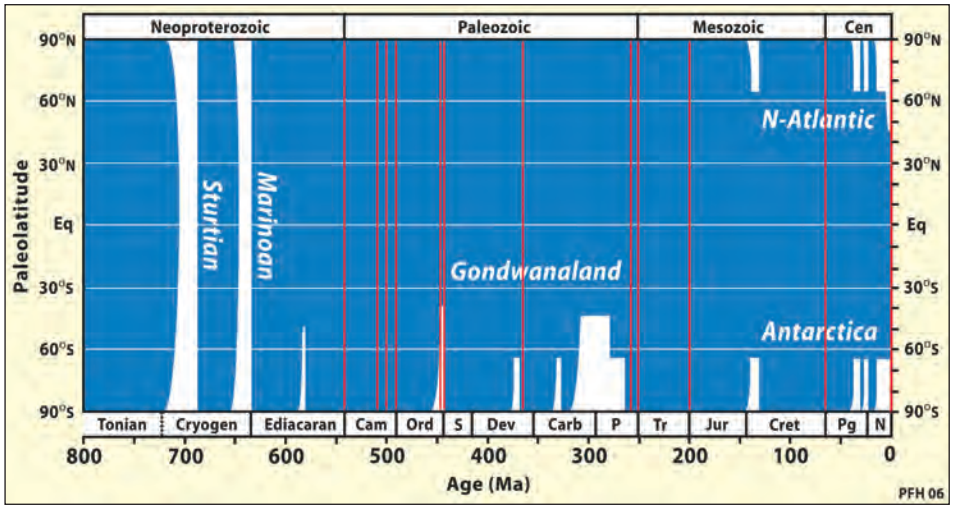
Snowball Earth: Frozen Oceans and Greenhouse Gases

Residents of the eastern half of the United States endured months of bone-chilling cold, coatings of ice, and deep snow drifts during the first few months of 2014 due to a "polar vortex." Yet the polar vortex ebbed allowing the return of more seasonable and temperate conditions. The residents of the supercontinent Rodinia were not so fortunate. According to plate tectonic reconstructions, Rodinia existed between 1.1 billion and 750 million years ago. Several times the Earth's global mean temperature plunged to less than 75 degrees below zero Fahrenheit, freezing over all of the world's oceans and shrouding the entire globe from pole to pole in a cloak of ice. Researchers have dubbed these episodes "Snowball Earth."



The most notable, and perhaps last, global freezing event occurred approximately 650 to 635 million years ago during the Marinoan Epoch glaciation toward the end of the Cryogenian period (850 to 635 million years ago) in the Neoproterozoic era (approximately 1 billion to 542 million years ago). Some researchers, including a team led by Huiming Bao, Charles L. Jones professor in geology and geophysics at Louisiana State University, contend that this last period of extensive glaciation and the subsequent climate changes might have given rise to modern levels of atmospheric oxygen. This set the stage for the rise of animals and the later explosive diversification of life forms during the episode called the Cambrian explosion.

The Snowball Earth concept posits that, during these exceptional cold events, the atmosphere was prevented from warming because most of the incoming solar radiation was reflected back into space by the whiteness of ice and snow covering the oceans and land surface. A lack of heat-retaining clouds and atmospheric moisture, caused by water vapor freezing out of the atmosphere, further amplified this effect. This resulted in average equatorial temperatures of about minus 10 degrees Fahrenheit, roughly similar to present-day conditions in Antarctica. Without the moderating effect of open oceans, the Earth's climate became much like that of Mars. However, due to some atmospheric sublimation (ice to vapor) and condensation, snow would continue to fall, glaciers would thicken and flow, and sedimentary deposits of glacial origin would be left behind as geological evidence of these severe conditions.



Paleogeographic extent of continental ice sheets and permanent sea ice over the last 800 Myr (red lines indicate major mass extinctions). Source: snowballearth.org

From The Editor *continued on page 9*

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Photo: James Elliott

From the President continued from page 5

to deal with as the AAPG examines its future. The AAPG shares some of the same problems with HGS, such as membership, and others that result from its international footprint and the need to provide products and services to a global membership pool with the associated overhead costs. A number of governance issues will be presented to the HOD for debate and approval. These proposals could change the future of the organization. Individuals will need to consider how the various proposals may impact the overall organization and not just their own individual circumstances. The individuals we select for these positions will need to be those that we trust with the future of the AAPG as it enters into a time of potential transition.

Once again, let me ask that you read about the candidates and vote with an understanding that the future of two organizations rests with that vote. Remember "elections have consequences," even those of professional societies.

Also, remember to join us this month at the George R. Brown Convention Center for the AAPG Annual Convention and Exhibition. It will be an opportunity to maintain, develop, and expand those all-important professional networks and to continue our education. A review of the technical program suggests that it will be outstanding. ■

Until next month…

From the Editor continued from page 7

A Princeton-led team of geologists analyzed samples of inorganic and organic carbon from the hills of the Trezona Formation in South Australia to document one of the largest perturbations to the carbon cycle in all of Earth history. Photo: Adam Maloof

In a January 2000 *Scientific American* article titled, "Snowball Earth," the authors Paul F. Hoffman and Daniel P. Schrag describe evidence from extreme icing events that occured as many as four times between 750 and 580 million years ago during the Neoproterozoic era. These icing events continued into the Ediacaran period (roughly 635-542 million years ago). The Ediacaran, the last period of the Neoproterozic, immediately precedes the Cambrian period of the Paleozoic. The Ediacaran period, named after the Ediacara Hills of South Australia, had its status as an official geological period ratified in 2004 by the International Union of Geological Sciences (IUGS), making it the first new geological period declared in 120 years.

Concept Origins

Thick geological deposits hold the only clues to the climate of the Neoproterozoic. For decades, many of those clues were riddled with contradictions. The foremost paradox was the occurrence of glacial debris in sediments deposited near sea level in the tropics. As observed in the January 2000 *Scientific American* article, glaciers near the equator today occur only above about 15,000 feet above sea level. Even during the ice ages of the Pleistocene, glaciers reached no lower than 12,000 feet in low-latitude areas. Mixed in with the Neoproterozoic glacial debris are unusual deposits of iron-rich rock which could form only if the oceans

From The Editor *continued on page 11*

From the Editor continued from page 9

and atmosphere contained little or no oxygen, even though by that time the atmosphere had already evolved to nearly the same mixture of gases as it has today. To confound matters, thick carbonate rock sequences, typical of deposition in warm seas, were observed to have been deposited on glacial deposits shortly after the ice receded.

Ice-rafted dropstone in proglacial marine strata, Ghaub Fm member, Otavi Group, Nambia. Source: snowballearth.org

Many geologists have grappled with these puzzling low-latitude glacial deposits. One of the earliest was the Australian geologist and Antarctic explorer Douglas Mawson (1882–1958). Sir Mawson, a Fellow of the Royal Society, on the first team to ascend Mount Erebus, Antarctica's tallest peak, and on the first team to reach the magnetic South Pole, spent much of his career studying the Neoproterozoic stratigraphy of South Australia where he identified thick and extensive glacial sediments. Late in his career, he speculated about the possibility of global glaciations. However, his ideas of global glaciation were hampered by the mistaken assumption that the geographic positions of Australia, and all the other continents were fixed in their present positions. Not until the development of the plate tectonic theory could geologists see the whole picture of low-latitude glacial deposits.

Albedo

Albedo, or reflection coefficient, from the Latin for "whiteness," refers to the fraction of solar radiation that is reflected back into space from a particular surface material. Albedo values range widely for various materials. Liquid water which readily absorbs solar radiation has a very low albedo, less than 0.1. Most absorption of solar energy on Earth today occurs in tropical oceans. Bare land has an albedo of approximately 0.3; ice ranges from about 0.45 to 0.65 depending on the bubble content; and fresh snow can range up to 0.9.

In 1964, the idea of global-scale glaciation reemerged when W. Brian Harland (1917 – 2003) published the paper "Critical evidence for a great infra-Cambrian glaciation" in the *International Journal of Earth Sciences*. In the paper, Dr. Harland presented paleomagnetic data showing that glacial tillites in Svalbard and Greenland were deposited at tropical latitudes. Based on the paleomagnetic data and the sedimentological evidence of glacial deposits interrupting successions of carbonate rocks commonly associated with tropical to temperate latitudes, he argued for an extreme ice age affecting the tropical regions.

Also in the 1960s, Mikhail Budyko (1920 – 2001), a Russian climatologist at the Leningrad Geophysical Observatory, developed an energy-balance climate model to investigate the effect of ice cover on global climate. Using this model, Dr. Budyko found that if ice sheets advanced far enough beyond the polar regions, to roughly 30 degrees of latitude, a feedback loop developed due to the increased reflectiveness of the ice and snow. The reflectiveness of ice and snow is known as albedo (see the text box).

The increased reflectiveness returns the incoming solar energy into space and prevents the Earth's surface from warming. This leads to further cooling and the formation of more ice, until the entire Earth was enveloped in ice and stabilized in a new ice-covered equilibrium in a run-away icehouse effect. While Dr. Budyko's model suggested that this shift to an ice-albedo stability could happen, he concluded that it had never happened, because his model offered no way for the Earth to escape from scenario of perpetual deep freeze.

The moniker "Snowball Earth" was coined by Joseph Kirschvink, a professor of geobiology at the California Institute of Technology, in a paper titled "Late Proterozoic low-latitude global glaciation: the Snowball Earth" published in a multidisciplinary study by the Cambridge University Press in 1992. The major contributions from this work were: (1) recognition that the presence of banded iron formations is consistent with a glacial episode where the atmosphere is depleted in oxygen and (2) introduction of a mechanism with which the Earth could escape from an ice-covered condition. This mechanism is the increasing accumulation of atmospheric carbon dioxide (CO_2) from volcanic outgassing leading to an ultra-greenhouse effect.

The Snowball Earth hypothesis was brought to widespread attention in the scientific community by the publication of "A Neoproterozoic Snowball **From The Editor** *continued on page 13*

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9:25AM

EXPLORING HYDROCARBON RESOURCES IN A DIVERSE ENVIRONMENT

5:25PM

EXPLORING CALM, BLUE WATERS ON A SUNSET SAIL

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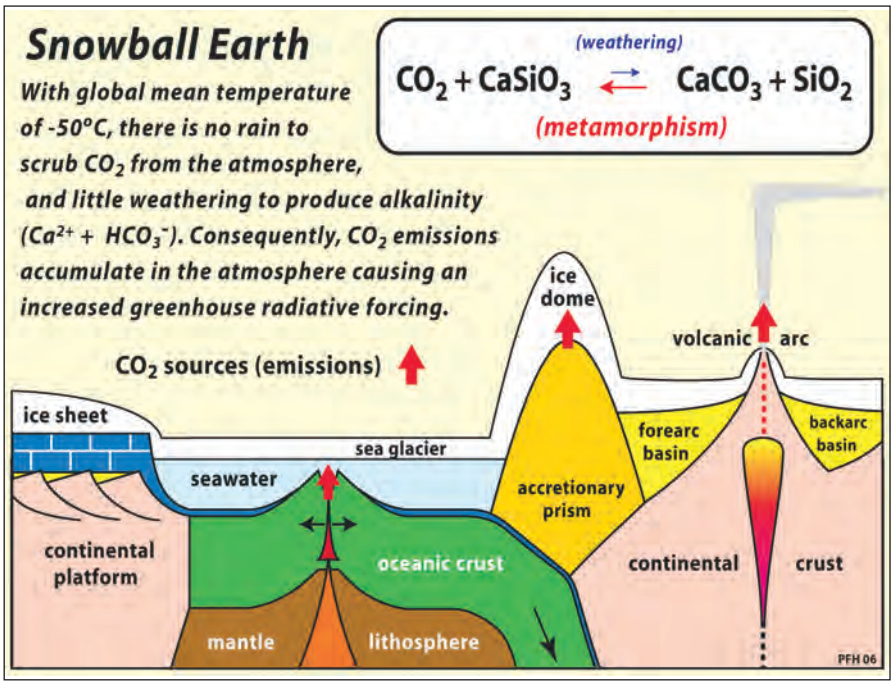
From the Editor continued from page 11



The geochemical carbon cycle on a snowball Earth. Volcanic and metamorphic CO_2 sources continue unaffected, but removal of CO_2 from the atmosphere is limited by the absence of rainfall. Silicate weathering is reduced by ice cover and cold ground temperatures. Source: snowballearth.org

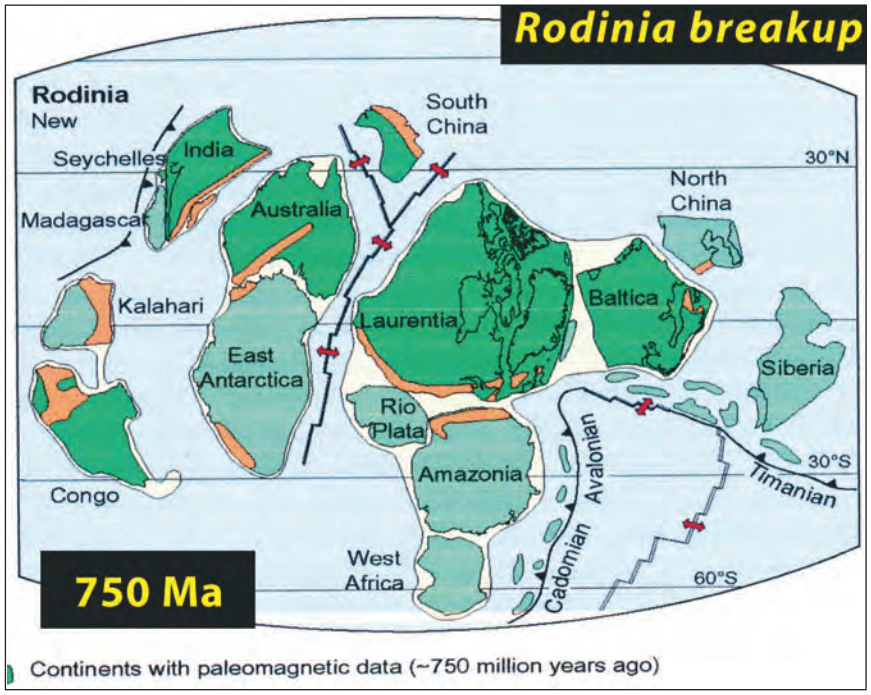
Earth," by Paul F. Hoffman, Alan J. Kaufman, Galen P. Halverson, and Daniel P. Schrag in the August 1998 issue of the journal *Science*. Dr. Hoffman, professor of geology at Harvard University, and his coauthors studied carbon isotope anomalies in carbonate rocks bracketing Neoproterozoic glacial deposits in Namibia. These glacial deposits included ice-rafted dropstones in equatorial marine strata. The authors combined their observations related to these anomalies with estimates of thermal subsidence history to develop the conclusion that biological productivity in the surface oceans collapsed for millions of years. They explained the collapse as related to ice-covered seas during global glaciations, that is, a snowball Earth. The authors went on to posit that these glacial episodes ended abruptly when sub-aerial volcanic outgassing raised atmospheric carbon dioxide concentrations to about 350 times greater than modern atmospheric concentrations. The increased carbon dioxide concentrations resulted in a rapid warming due to extreme greenhouse conditions. Additionally, the transfer of atmospheric carbon dioxide to the ocean resulted in the rapid precipitation of calcium carbonate in warming surface waters, producing the carbonate rocks observed globally capping the Neoproterozoic glacial deposits.

How did it Happen?

While geological evidence of Neoproterozoic glaciations is strong, a thorough understanding of the mechanisms that caused the extreme temperature plunge is incomplete. Current thinking is that a reduction in the concentration of "greenhouse" gases, particularly carbon dioxide and methane, led to a globally colder climate. The colder climate allowed areas of ice to expand from the polar regions into lower latitudes. Researchers theorize that when the earth became approximately 50 percent covered by ice, the global climate reached a tipping point where the solar radiation was no longer able to warm the Earth surface due to the increased albedo leading to a runaway icehouse effect.

But what caused the lowering of atmospheric concentrations of the greenhouse gases? CO_2 cycles through the atmosphere and ocean starting with volcanic emanations and ending with removal as calcareous sediments and organic matter. In the atmosphere, CO_2 forms a weak carbonic acid with precipitation. After falling on land, the slightly acidified precipitation is neutralized by the weathering of silicate rocks, a process particularly active in warmer climates.

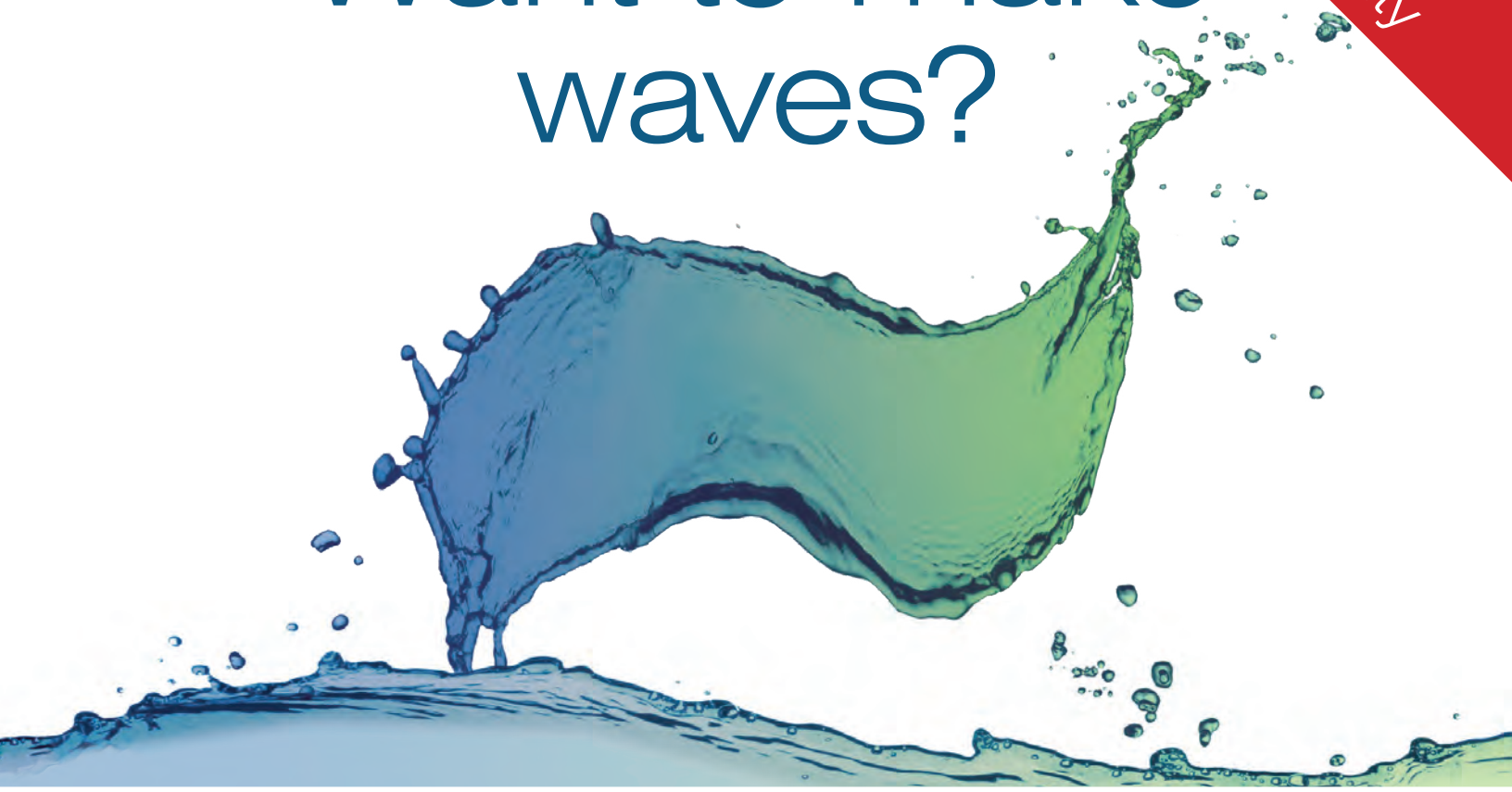
From The Editor *continued on page 15*



Breakup and dispersal of the Rodinia supercontinent (Torsvik, 2004). Source: snowballearth.org

Career Opportunity

Want to make waves?



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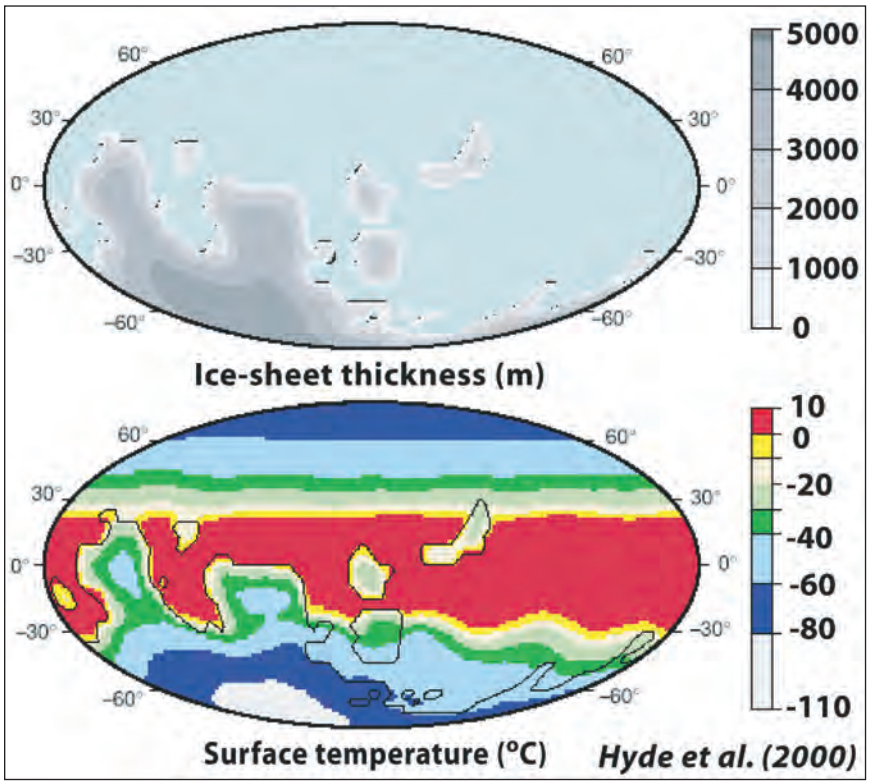
From the Editor continued from page 13

These processes remove carbon from the atmosphere and transfer it to the world's oceans as bicarbonate ions. The bicarbonate is removed from the oceans primarily by biological activity as calcium carbonate. The calcium carbonate settles to the bottom and enters the lithosphere.

Paleomagnetic data indicate that during the Cryogenian period, encompassing the Sturtian and Marinoan glaciations, most of the continental landmasses were located in the Earth's warmer equatorial regions. This suggests that the rate of silicate weathering was high, lowering atmospheric CO_2 concentrations, slowing greenhouse heating, and cooling the global climate. The global cooling lowered the silicate weathering rate, ultimately stabilizing the climate system at a new colder state.



Slushball Earth: Simulation using a general circulation model with coupled ice-sheet dynamics model with Ediacaram paleogeography in which a loose supercontinent stretches from pole to equator. Within a prescribed range of CO_2, equatorial margins of the supercontinent are glaciated, as a result of ice-sheet flowage, while the tropical ocean remains above the freezing point. Source: snowballearth.org

Two additional phenomena are known to have occurred at the time, further contributing to high silicate weathering rates and lower CO_2 concentrations. The first was the breakup of the pre-Pangean supercontinent named Rodinia which began approximately 830 million years ago and continued for nearly 200 million years. Silicate weathering rates are thought to be low when a supercontinent exists because most land area is far from the ocean and therefore very dry. When a supercontinent breaks up, formerly arid regions become wetter increasing weathering rates and reducing atmospheric CO_2 concentrations.

The second phenomenon was the massive eruption of flood basalts around 723 million years ago in the present-day Canadian arctic which then lay close to the equator. Basalts weather rapidly and are a rich source of calcium ions. Model simulations published in the a February 2004 letter to the journal *Nature* titled "A 'snowball Earth' climate triggered by continental break-up through changes in runoff" by Yannick Donnadieu, Yves Goddéris, Gilles Ramstein, Anne Nédélec, and Joseph Meert indicate that the combined effects of equatorial continents, supercontinent breakup, and low-latitude flood basalt emplacement are sufficient to cause a depression of atmospheric CO_2 concentrations and trigger a global glaciation episode.

Survival of Life

An ice-covered Earth would curtail photosynthetic life on Earth and thus drastically deplete atmospheric oxygen. Detractors argue that this kind of glaciation would have made life extinct entirely. However, microfossils such as stromatolites and oncolites prove that, in shallow marine environments at least, life did not suffer any significant disruption. Proponents theorize that life could have survived or even flourished in the following locations:

- Deep oceanic hydrothermal vents.
- Under the ice in chemolithotrophic (mineral-metabolizing) ecosystems theoretically resembling those in existence under modern glaciers.
- Small regions of deep, open, ice-free ocean far from the supercontinent Rodinia, where photosynthesizers could have access to light and CO_2.
- On high mountain areas in the tropics where daytime tropical sun or volcanic heat could create small temporary melt pools.
- In pockets of liquid water within and under the ice caps, similar to Lake Vostok in Antarctica.
- In small oases of liquid water near geothermal hotspots resembling Iceland today.

A continuing mystery is that the fossil record indicates that organisms and ecosystems do not appear to have undergone the significant change that would be expected by an extreme climate event or a potential mass extinction associated with the global glaciations. Even if life were to cling on in all the ecological

From The Editor *continued on page 17*

From the Editor continued from page 15

refuges listed above, a whole-Earth glaciation should result in a biota with a noticeably different diversity and composition. This change in diversity and composition has not yet been observed in the fossil record — in fact, the organisms which should have been most susceptible to climatic variation emerge unscathed from the Snowball Earth.

Escape from Snowball Earth

Climate models, such as those developed by Dr. Budyko, suggest that once the Earth is covered in ice there would be no escape. Solar radiation, largely reflected by the glittering white surface, would be insufficient to loosen the icy grip. Yet, our currently ice-free tropics and temperate world indicate that the atmosphere warmed sufficiently to end the glacial event. Geological evidence indicates that elevated levels of CO_2 concentrations in the atmosphere from volcanic outgassing led to rapid warming. Atmospheric concentrations of CO_2 during a period of global glaciation would continue to increase because there were no open ocean surfaces to absorb the gas and no precipitation to remove it.

As advanced in the paper "CO_2 levels required for deglaciation of a 'near-snowball' Earth," by the authors Thomas J. Crowley, William T. Hyde, and W. Richard Peltier from the Department of Oceanography, Texas A&M University, published in the January 2001 *Geophysical Research Letters of the American Geophysical Union*, the CO_2 levels necessary to unfreeze the Earth are estimated to have been about 130,000 parts per million, or 13% of the atmosphere. Their research indicates that, over 4 to 30 million years, enough CO_2 and methane, mainly emitted by volcanoes, would accumulate to finally cause a strong enough greenhouse effect to lead to surface ice melting in the tropics. Eventually, an equatorial band of permanently ice-free land and water developed. Methane trapped in equatorial permafrost would be released adding to the greenhouse warming. The newly-exposed ocean and ground would be darker than the ice, and thus absorb more energy from the sun — initiating a "positive feedback" furthering the global meltdown.

On the continents, the melting glaciers would release massive amounts of water and glacial sediment flowing to the oceans. The resulting sediments supplied to the ocean would be rich in mineral nutrients which, combined with the abundance of CO_2, would trigger a cyanobacteria population explosion, causing a relatively rapid re-oxygenation of the atmosphere. Researchers suggest that this vastly different oxygen-rich world was the setting for the rise of the Ediacaran biota and the subsequent Cambrian explosion. This positive feedback loop of mechanisms would free the Earth from ice in an astonishingly short period of time, perhaps less than 1,000 years. However, replenishment of atmospheric oxygen and depletion of the CO_2 levels by ocean absorption and biological uptake would take further millennia.

Conclusion

Any theory that describes a radical departure from conventional models is sure to have critics. The Snowball Earth concept is no exception. The great antiquity of the Neoproterozoic glacial era deposits makes determinations relative to timing, global extent, and duration difficult and subject to uncertain interpretations in this developing area of study. Yet the geologic evidence for the occurrence of equatorial glaciations at this time is not disputed. However, the mechanisms, triggers, and processes that could lead to an ice-covered Earth continue to draw much debate. Does the Earth's climate have a tendency to shift to a colder state? "Indeed, one of the great puzzles is why hasn't this extent of global freezing happened since the Proterozoic," said Jerry McManus, paleoclimatologist and professor of geological sciences at Columbia University's Lamont-Doherty Earth Observatory in New York. Some scientists theorize a less severe Snowball Earth scenario that they term "Slushball Earth," where the oceans were covered in a loose icy mush with large areas of open water rather than a rigid frozen surface.

But one thing is certain, faced with future Snowball Earth conditions, salt supplies at the hardware store would run out very quickly. "We're gonna' need a bigger snow shovel." ■

Letter to the Editor

Mr. Forlenza,

I enjoy reading your column in the HGS *Bulletin* each month. I am not an expert on wine, but the role geology has on various enterprises is of interest to me. My cousin and his wife started a winery in Paso Robles a few years back and named it Caliza (a Spanish term for limestone). Carl is not a geologist, but with all of the carbonate rocks in the area (as with the winery in your February column) and his wine-making education he chose a name to describe the terroir of the area. I thought he was pretty clever to incorporate geology into the name of his winery, but your column demonstrates that it is not that unusual. Thanks for your column each month.

Kent Bowker
HGS Member

2014 HGS Foundation Scholarship Awards Night

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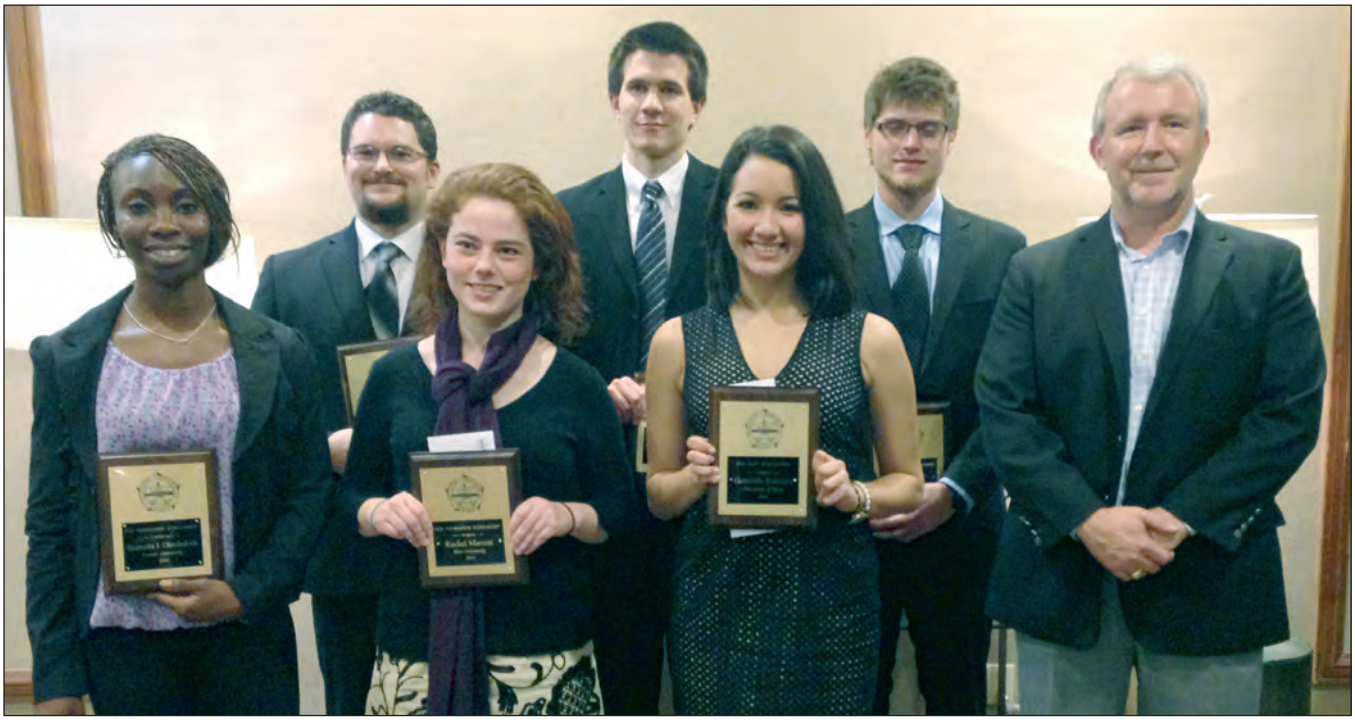
HGS Undergraduate Scholarship Foundation Presents Six Scholarships

The HGS Undergraduate Scholarship Foundation has provided over $240,000 in scholarships to deserving geoscience students since 1984. This year the Foundation awarded scholarships totaling $16,000 to students from six universities participating in our program. Gabrielle Ramirez from the University of Texas was awarded the Maby Scholarship, presented each year to the Foundation's top applicant. Foundation Chairman John Adamick presented the scholarships to the recipients at the February 10, 2014 HGS General Dinner meeting. The Foundation was also fortunate to have a number of corporate sponsors support our program and attend the award ceremony. Sponsors for 2014 included Tigereye Resources, Chevron, Ursa Resources, Ecopetrol, Noble Energy, SM Energy, Energy XXI, TGS, Core Lab, and Vitruvian Exploration II. Thank you sponsors for your generous support!

Vitae for our scholarship winners are provided below. These students are to be commended for their accomplishments.
John Adamick
HGS Foundation Chairman



Gabrielle Ramirez
Maby Scholarship recipient
University of Texas

Gabrielle Ramirez is a junior at the University of Texas pursuing a degree in geology. She serves as an officer in both the Undergraduate Geological Society and the Geosciences Leadership Organization for Women and has been constantly involved in her geology department as a research assistant and employee of the Jackson School's GeoForce program. She is a Jackson Honors student currently working on her honors thesis with Dr. John Lassiter in the discipline of geochemistry. In the summer of 2013, Ms. Ramirez completed an REU project with museum curator Dr. Benjamin Andrews at the Smithsonian National Museum of Natural History in Washington, DC looking at the sedimentation of pyroclastic density currents and has since then presented at multiple conferences across the country. Besides being a student, she enjoys painting and experiencing the live music and food of Austin. After graduation in May 2015, she has plans to attend graduate school and pursue a career in industry.

Undergraduate Scholarships *continued on page 21*

HGS Undergraduate Scholarships *continued from page 19*

Daniel Burton
University of Houston

Daniel Burton is a junior at the University of Houston pursuing a double major in geology and geophysics after switching from the business school at the start of his sophomore year. He is currently the Treasurer of GeoSociety at UH and a member of the Honors College. This semester he begins participating in research on the isotope geochemistry of serpentinites from near Guatemala's Motagua fault system with Drs. Jinny Sisson, Alan Brandon, and Steven Goderis. He also volunteers at an active Pleistocene paleontological dig. After graduation, Mr. Burton plans to attend graduate school and work in the petroleum industry.

David Reynolds
Sam Houston State University

David Reynolds is a senior at Sam Houston State University and is completing a degree in geology with a minor in political science. Since March 2010, he has worked as a lab technician at Weatherford Laboratories - Geochemical Group in The Woodlands, Texas. During his time with Weatherford, he has performed total organic carbon testing with LECO technology, headspace gas composition testing with automated gas chromatograph technology, and hydrocarbon extraction from rock and mud for gas chromatography - mass spectrometry. Prior to transferring to SHSU, he graduated Suma Cum Laude with Associate of Science and Associate of Arts Degrees from Lone Star College – Montgomery where he became a member of Phi Theta Kappa Honor Society. At SHSU, Mr. Reynolds has continued to excel in academics as well as enjoyed working as a teaching assistant. He is a member of Sam Houston Association of Geology Students and Sam Houston State University AAPG Chapter. He enjoys riding horses, camping, golfing, and spending time with his family and friends. Mr. Reynolds's goal is to always grow as a family man, friend, individual, and professional as he builds a successful career in the oil and gas industry.

Jonathan (Jon) Ehrhart
Stephen F. Austin State University

Jon Ehrhart is a senior at Stephen F. Austin State University with a major in geology and a minor in geographic information systems. He has consistently made the Dean's list and received two outstanding student departmental scholarships. He has served as the vice president for the Gamma Phi chapter of the Sigma Gamma Epsilon Honor Society since 2012 and is a member of AAPG. His academic interests are in sedimentary basin development with a focus on hydrocarbon exploration. He enjoys outdoor activities like camping and fishing and is an enthusiastic member of the East Texas Jeep club. After he graduates from Stephen F. Austin, he plans to attend graduate school and pursue a successful career as a petroleum geologist.

Rachel Marzen
Rice University

Rachel Marzen is a junior at Rice University majoring in earth science. She became interested in the geosciences in high school while working at the US Geological Survey using microfossils to analyze Earth's climate history. She returns to this lab any chance she gets on college breaks. Last summer, she was an IRIS (Integrated Research Institutions for Seismology) intern at Scripps Oceanography and presented her research on azimuthal anisotropy beneath Hawaii at the AGU Fall Meeting. In addition to the geosciences, Ms. Marzen enjoys being the treasurer of the Rice Houston Humane Society, a Head Peer Academic Advisor at Wiess residential college, and a member of the Rice Chorale. She is grateful for the knowledge, advice and support she has gained from her teachers and research mentors, and plans to go to graduate school for geophysics after she graduates in 2015.

Ijeamaka Okechukwu
Lamar University

Ij Okechukwu is a senior at Lamar University majoring in geology. She earned recognition on the President's List in 2012 and more recently on the Dean's List in fall 2013. Ms. Okechukwu is currently working on her seminar project under the supervision of Dr. Joseph Kruger. Her research involves quantifying gravitational anomalies and elevation changes in Southeast Texas. She has also done research involving geochemistry and paleoclimate studies using stable isotopes at the University of Texas. She is the current secretary of Lamar University Geological Society. She was a member of Lamar's chapter of Sigma Xi Research Society and is currently a member of Geological Society of America. Ms. Okechukwu also plays on Lamar's Women's Club Basketball team and she enjoys cooking and do-it-yourself handiwork. She hopes to either start her career after graduating or go to graduate school to study subsurface geology. ■

Candidates for the 2014–2015 Executive Board

Houston Geological Society Officer Election

The candidates put forth by the Nominations Committee are:

President-elect: John Dombrowski, Deborah Sacrey

Vice President: Mike Erpenbeck, John Jordan

Secretary: Ashley Garcia, Diana Phu

Treasurer-elect: Sean Kimiagar, Larry Quandt

Editor-elect: Jon Blickwede

Directors (2 positions): Jim Grubb, Penny Patterson, Dave Tonner, Justin Vandenbrink

HGS Election Voting Instructions

HGS members will soon receive a ballot with biographical sketches of the candidates.

Members will be able to vote in one of two ways:

by returning the paper ballot that will be delivered in the mail,

OR

by voting online following instructions that will be delivered by e-mail.

PLEASE VOTE – Upon receiving the paper ballot or the e-mailed instructions!

The voting period opens April 10, 2014 and continues to May 10, 2014.

President-elect (two candidates)

John Dombrowski

Education:

M.S. Geology, Washington State University, 1976

B.S. Geology, Grand Valley State College, 1973

Experience

2007 – Present	Peace River Group, LLC Partner
2005 – 2007	Circle Oil, Plc. Project Manager
2000 – 2004	Fortesa International Inc. Exploration Manager
1999 – 2000	First Exchange Corporation, Inc. Consultant
1994 – 1999	Texaco North American Production, Inc. Senior Geoscientist
1988 – 1994	Texaco Exploration & Production, Inc. Area Manager
1987 – 1988	Texaco Exploration & Production, Inc. Assistant Regional Manager
1984 – 1987	Texaco Exploration & Production, Inc. Project Leader
1975 – 1984	Texaco Exploration & Production, Inc. Exploration Geologist

Professional Affiliations

AAPG, SEG, HGS, GSH, NOGS

Professional Activities

2012 – 2014	Houston Geological Society, Director
2013 – 2014	AAPG House of Delegates, Foreman

John Dombrowski *continued on page 28*

Deborah K. Sacrey

Education:

B.S. Geology; University of Oklahoma, 1976

Experience:

1990 - Present – Consultant Geologist/Geophysicist, Houston, TX

1988 -1990 – Staff Geologist – Weeks Exploration, Houston, TX

1986 -1988 – Chief Geologist – Peko Oil Company, Dallas, TX

1983 -1986 – Consultant, Dallas, TX

1980 -1983 – Sr. Geologist – Old Dominion Oil Corp., Oklahoma City, OK

1978-1980 – Jr/Sr. Geologist – Michigan-Wisconsin Pipeline Co., Oklahoma City, OK

1976-1978 – Staff Geologist – Gulf Oil Company, Oklahoma City, OK

Professional Affiliations:

Houston Geological Society (HGS) - 1989

Oklahoma City Geological Society (OCGS) - 1976

American Association of Petroleum Geologists (AAPG) - 1976

DPA Certified Petroleum Geologist #4014;

Certified Petroleum Geophysicist #2

Society of Exploration Geophysicists (SEG) - 1989

Society of Independent Professional Earth Scientists (SIPES) #1271 – 1983

Deborah K. Sacrey *continued on page 29*

Candidates for the 2014–2015 Executive Board *(continued)*

Vice President (two candidates)

Mike Erpenbeck

Education:
B.S. Geology, San Diego State University 1977
M.S. Geology, Texas Tech University 1979
MBA, Finance, University of Houston 1989

Experience:

2012-present	Upstream Advisors Group – Manager
1997-2012	Ziff Energy Group – Senior Analyst, Project Manager, Manager U.S. Studies, Senior Associate
1990-1997	UMC Petroleum – Revenue/Gas Balancing Accountant, Special Projects, Accounting Analyst
1987-1990	Various Firms – Consulting Geologist
1983-1987	Hemus Oil & Gas – Manager of Geology
1981-1983	Pilgrim Exploration – Geologist
1979-1981	Texas Oil & Gas (TXO) – Geologist

Summary of Relevant Experience:
I have performed a wide variety of functions within the oil and gas industry over the past 30+ years. Throughout these experiences, and especially most recently, I have been tasked with the observation of industry trends and making strategic recommendations. This has afforded me the opportunity to take a big picture view of global and domestic activity, as well as technological and operational trends within regions and fields. I believe this strategic view will serve me well if elected to the Vice President position in HGS, whose job it is to determine and line up the topics and speakers for the General Lunch and General Dinner meetings.

As a Board member of HGS for the past two years, I have been a part of the decision-making to provide strategic direction to the Society. We have discussed and debated at length the nature of the needs and desires of the members, in light of the rapid technological change and the shifting demographics within the HGS. As Treasurer, I have had the opportunity to relate financial data to measures of success of our meeting attendance, providing a further gauge of members' interests.

Statement:
I am honored to be in the position to be asking for your vote to help lead this great organization, the largest of its kind in the world. It was later in my career that I became actively involved in HGS, and I realize, a bit late in the game, how gratifying it is

Mike Erpenbeck *continued on page 31*

John E. Jordan

Education:
M.Sc. Geology/Geophysics 1981 Wright State University, Dayton, Ohio
B.S. Geology/Geophysics 1979 Wright State University, Dayton, Ohio

Experience:

1996 – Present	Kerr McGee Oil & Gas / Anadarko Petroleum Co.
1993 – 1996	Samedan Oil & Gas
1987 – 1996	Arco Oil & Gas Southern District
1985 – 1987	Consultant
1981 – 1985	Chevron USA Western Region

Professional Affiliations:
HGS, AAPG, AAPG HoD, DPA, SEG and TBPG

Professional Activities:
HGS:
Treasurer
Board of Directors (2 terms)
Chariman of the International Explorationist Group

AAPG:
Delegate (18+ years; foreman one term)
AAPG Membership committee
AAPG Survey Committee
DPA membership committee
Started and was first President of WSU student AAPG chapter (1980)

Statement:
I have been an Active HGS member since 1985 when I moved from Northern California to Houston. I was out of work and I knew almost no one. The HGS monthly meetings were a great place to meet fellow geoscientists, learn about Gulf Coast geology and develop my career. The HGS offered relevent and many short courses where I learned about petroleum systems and how to value producing oil and gas properties. Later, when I moved into international exploration in the 1990s, the HGS was how I learned about oil and gas plays around the world.

The HGS is a unique organization. It is the largest local geological society in the world and represents a melting pot of domestic and internationally-focused geologists. It has achieved this standing

John E. Jordan *continued on page 31*

Candidates for the 2014–2015 Executive Board *(continued)*

Secretary (two candidates)

Ashley Garcia

Education:
M.B.A., University of Houston, 2012
B.S. Biology, Texas A&M University, 2006

Experience:

2011 – present	Assistant Program Manager Gulf of Mexico, ION Geophysical
2010 – 2011	Sales Operations Analyst, ION Geophysical
2006 – 2010	Products Marketing & Sales Support Specialist, ION Geophysical

Professional Affiliations:
Houston Geological Society
Gulf Coast Section SEPM

Statement:
It is an honor to be nominated for Secretary of the Houston Geological Society. Over the last four years, I have been heavily involved in the society, participating in the Exhibits, Legends Night, Technofest, and Mudrocks committees and events, just to name a few. And in return, HGS has provided me with great networking, friendship, education, and other personal and professional benefits. I feel very passionate about continuing the society's growth and success. Therefore, I wish to volunteer my time and capabilities in this capacity so that the HGS remains the 'largest local geological society in the world,' providing other professionals and geoscientists the same benefits it has given me. Thank you for your consideration. ■

Dianna Phu

Education:
B.S. (cum laude) Geology/Geophysics
University of Houston, Houston

Work Experience:

2011-Present	Senior Geologist, INTECSEA
1999-2011	Senior Geologist, Geoscience Earth & Marine Services, Inc.
1997-1999	Lab Assistant, UH Thermochronology Laboratory

Professional Affiliations:

HGS	GSH	AAPG	AAPG DPA
SEG	GSA	SEPM	AGU

Professional Activities:

2010-Present	HGS Social Media Chairperson
2013-Present	AAPG DPA Gulf Coast Councillor Alternate
2013-Present	AAPG DPA Website Committee Chair
2006-Present	OTC "The Next Wave" Planning Committee Member
2006-Present	HGS Continuing Education Committee Member
2013	OTC "The Next Wave" Committee Chair
2012	AAPG Annual Convention (Long Beach, CA) House of Delegates, HGS Alternate
2007-2010	HGS Arrangements Committee
2007-2012	GSH-HGS Geoscience Day Planning Committee
2005-2007	HGS NeoGeos Chair

Statement:
It is a great honor to be considered for the role of Secretary of the Houston Geological Society. I have tremendous appreciation for the many volunteers that selflessly put their time and effort towards keeping the Society moving forward. As Secretary, my responsibility will be to document the activities of the Society and decisions of the Board through the 2014-2015 season. I have gained valuable experience with the HGS through my involvement across multiple committees over several years. I am proud of the growth in the NeoGeos that came with the years of service (and support from my wonderful family) while I served as the committee's chair. I am also proud to see the HGS's presence in the realm of social media continue to grow and contribute back to our members, the Society, and our local and global community. I would be proud to serve the HGS in the capacity of Secretary for the 2014-2015 season. ■

Candidates for the 2014–2015 Executive Board *(continued)*

Treasurer-elect (two candidates)

Sean Kimiagar

Education
M.S., Geology, University of Texas at Arlington (2013)
B.S., Geology, Petroleum Institute in Abu Dhabi, a CSM-affiliated school (2010)
Stanford University, Graduate School of Business – Summer Institute for General Management (Summer 2010: Student, Summer 2011: Program Counselor)

Experience
Halliburton – Geologist & Earth Modeler (2013 – Present)
BHP Billiton Petroleum – Geoscience Intern (2012)
Abu Dhabi National Oil Company – Geoscience Intern (2009)

Professional Affiliations
HGS, AAPG, SEG, FWGS (Fort Worth Geological Society)

Professional Activities
HGS – Finance Committee Chair (2013 – Present)
AAPG Young Professionals – West Houston Liaison (2013 – Present)
AAPG – Houston Student Expo – Halliburton representative on the Jobs Panel (2013)
AAPG Regions Committee Member (2009 – 2012)
AAPG Student Chapter President (2008 – 2010)
SEG Student Chapter President (2008 – 2010)

Statement
I am delighted to have been asked to stand for election for the office of HGS Treasurer-elect. I am currently the Chair of the HGS Finance Committee, where I interface directly with the HGS Treasurer. As Finance Chair, I am with the team responsible for the HGS investment portfolio, which aims at steadily increasing the Society's asset base, contributing to the healthy growth of the Society. This in turn gives the Board more leverage in providing more services and value to HGS members. My current chairmanship also puts me in the position of coordinating all committee budgets for the annual budget presentation to the Executive Board. I also assist the current Treasurer-elect at the sign-up table for General Dinner events. I feel these activities are preparing me well for Treasurer-elect and Treasurer responsibilities, should I win election to these offices and have the privilege of serving the society. ■

Larry R. Quandt

Education:
B.S. Geology, Bemidji State University
M.S. Geology, University of North Dakota

Experience:

1990-2006	Minnesota Pollution Control Agency
2006-present	Core Laboratories

Professional Affiliations:
HGS, AAPG, SPE, JSR

Statement:
I would like to serve the HGS as the Treasurer-elect, and subsequent Treasurer for the next term. I strongly believe each of us should find time to volunteer to give something back to the science that has brought me enormous challenge and fulfillment and delivered so much to the community where we live.

I have been a member of the HGS since 2007. I first started volunteering in the North American Explorationists Group manning the registration table at the Monday night dinners and eventually becoming the Treasurer of the North American Explorationists Group. The committee is a great group of people interested in the exchange of information and the group is an excellent opportunity to get acquainted with others involved with exploration and development of oil and gas in North America. Serving on the committee and attending the Monday night dinners has returned benefits ten-fold in networking opportunities and learning about the exploration and development of oil and gas.

The HGS is an outstanding society at providing educational and networking events. These activities require funding, but some also generate funding for the HGS. I will do my best to see to it that all the HGS funds are used wisely and prudently.

I am honored to be asked to run for Treasure-elect and Treasurer. If I'm elected this will be my first elected office and I will serve the office honorably and with integrity. ■

Candidates for the 2014–2015 Executive Board *(continued)*

Director – Two-year term *Vote for two candidates*

James M. Grubb

Education:
Bachelor of Science, Business Administration, Bowling Green State University – 1962-1966
Bachelor of Science, Geology, Bowling Green State University – 1962-1966
Master of Arts, Geology, Bowling Green State University – 1966-1968

Work History:

2008 to Present	Exploration Manager – Slawson Exploration Company
2003 to 2008	Geologist/Partner – Premier E&P LLC.
1996 to 2003	Director of Exploration – J.M. Huber Corporation
1993 to 1996	Vice President of Exploration –L.B. Simmons Company
1989 to 1993	Geologist/Partner – JMARK Exploration Company
1984 to 1989	Exploration Manager – Louisiana Land and Exploration
1974 to 1984	Area Exploration Manager – Aminoil, USA, Inc.
1968 to 1974	Geologist/Geophysicist – Chevron Oil Company

Affiliations:
AAPG, DPA, SIPES, HGS, OEI

Statement:
I am nominated for the Houston Geological Society, Director 3 position. I am running for this office because I have enjoyed the benefits of this dynamic organization for over 20 years and would like to contribute to the future growth of this organization. I have found my membership in HGS to be very rewarding and fruitful. I enjoy the fellowship of the monthly luncheons and dinner meetings and I find the talks and the courses offered to be very useful and informative. It is always a good time to meet new and interesting people and share our experiences. I enjoy geology and the rewards of exploration geology. I plan to continue working in this field as long as I may. I have served on the Board of SIPES and found it to be a very rewarding time and would like to contribute to HGS in a similar manner. ■

Penny E. Patterson

Education:
1990, Ph.D., Geology, University of Colorado
1981, M.S., Geology, University of Colorado
1976, B.A., Geology, University of Colorado

Experience:

1976 - 1978	Field Assistant, USGS
1981 - 1986	Geologist, Research Planning Institute
1990 - Present	Senior Technical Advisor, ExxonMobil Exploration Company

Professional Affiliations:
Houston Geological Society (12 years)
American Association of Petroleum Geologist (31 years)
Society of Economic Petrology and Mineralogy (31 years)

Professional Activities:
2007-Present, University of Colorado Advisory Board

Statement:
The Houston Geological Society is a vibrant organization that provides an outstanding venue that brings together geoscientists from academia and industry promoting and advancing new technology and concepts. The HGS provides career development opportunities and offers state of the art training and education for our geoscience community. The HGS publication and HGS website are vast resources for all geoscientists in the Houston area and demonstrate the multitude of facets of the society, including lecture series, networking platform, and education opportunities.

I enthusiastically support HGS and have enjoyed the camaraderie and benefits of networking with fellow geoscientists. If elected to the Board of Director of HGS, I would work diligently to support and advance HGS's fundamental objectives of promoting the advancement of geology in the Houston area through supporting technical meetings, assisting with the continuing education program, and assisting the student scholarship funding program. ■

Candidates for the 2014–2015 Executive Board *(continued)*

Director – Two-year term *Vote for two candidates*

David Tonner

David Tonner is Weatherford's director of global sales and Regional Business Unit Leader for North America , Surface Logging Systems and has over 25 years of experience in the oil and gas industry. He received his B.Sc (Geology) from the University of Nottingham (UK) and has spent his entire career in the field of surface logging. He has a keen interest in advanced mud logging applications using measurements on rock cuttings, gas in mud and drilling parameters. Focus areas are high resolution surface gas measurements to predict hydrocarbon fluid type while drilling, geochemical signatures of rock cuttings as it relates to stratigraphy, geomechanical properties and production potential. Pore pressure prediction and early kick detection for risk mitigation. He has held various positions from Mud Logging geologist, Pressure Engineer, Country Manager, Regional Manager and Senior Executive Sales. He has worked for Geoservices, Datalog Technology and International Logging prior to joining Weatherford when the latter was acquired in 2008. Dave is currently an active committee member with the Houston Geological Society Northsiders group and holds the position of Co-Chair. ■

Justin Vandenbrink

Education:
B.Sc. Geology, University of British Columbia, 1994
Diploma Communications/PR, B.C.I.T, 1998

Experience:

2012–present	Weatherford, Global Manager Wellsite Geology and Pore Pressure
2001–2011	RPS Energy, Geological Operations Manager
1998–2001	Broadcasting
1995–1996	Inmet Mining – Exploration Geologist
1994–1995	Rennaissance Energy – Exploration Geologist

Professional Affiliations:
AAPG, HGS, GSH, SPWLA, DGS, CSPG
APEGGA Professional Geologist #80794

Professional Awards and Activites:

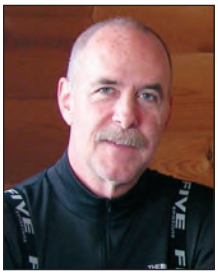
2012 – 2013	HGS Vice President
2012 -	HGS Africa Committee
2009	HGS Career Day Speaker
2008–present	HGS International Exploratonists Chairman
2008–2009	HGS Holiday Party Organiser
2006–2008	APEGGA – MC for Graduates Workshop & Ring ceremony

Statement:
I am a professional geologist currently working as the Global Manager for Wellsite Geology and Pore Pressure Consulting with Weatherford. I have worked as a geologist and in business development for the past 19 years in exploration both domestically and internationally.

Maintaining contacts and sharing knowledge with industry peers is essential for all of us in oil and gas. The HGS is one of the best venues for this. Working as a past Vice President and Chair of the International Explorationists committee has given me good perspective on why I need to continue to volunteer to help the HGS move forward. I am honored to run as Director for the HGS Board in 2014. ■

Candidates for the 2014–2015 Executive Board *(continued)*

Editor-elect (one candidate)



Jon Blickwede

Education:
M.S. Earth Sciences, University of New Orleans
B.S. Geology, Tufts University

Experience:

2005-present	Statoil- Exploration Geologist
2002-2005	Unocal- Exploration Geologist
2000-02 & 1997-98	Petroconsultants/IHS- Regional Manager, Mexico & Caribbean
1998-2000	Andrews Group- Manager of Geosciences
1981-1997	Amoco- Exploration Geologist

Professional Affiliations:
AAPG, HGS

Professional Activities:

2011-present	AAPG-Chairman, Publication Pipeline Committee
2007	GCS-SEPM-Technical Committee Co-chair, Perkins Research Conference
2004	AAPG-Technical session co-chair, Deepwater Frontiers, ICE, Cancún, Mexico
2004	GCAGS-Symposium co-chair, Petroleum Systems of the Northern Deepwater Gulf of Mexico, Annual Convention, San Antonio
2003	AAPG-Co-editor, Memoir 79, The Circum-Gulf of Mexico and Caribbean: Plate Tectonics, Basin Formation and Hydrocarbon Habitats
1994	Sociedad Venezolana de Ingenieros Geofísicos-Secretary, Annual Congress
1989	GCS-SEPM-Technical Committee member, Perkins Research Conference
1983-85	New Orleans Geological Society-Chairman, Short Course Committee

Statement:
I am honored to have been nominated to serve as Editor-Elect of the HGS Bulletin and thereby help to ensure its continued reputation as one of the world's premier periodicals of local geoscience societies. It's also a great opportunity for me to contribute some of my time and talents to HGS and the entire Houston geological community. ■

continued from page 22

John Dombrowski—*Candidate for President-elect*

2012 – 2013	Houston Geological Society Distinguished Service Award
2007 – 2010	HGS International Committee, African Conference
2007 – Present	AAPG Houston, House of Delegates.

Statement:
This is the section where candidates offer their reasons of why they agreed to stand for office. Oftentimes the recurrent themes of "obligation," "service," and "giving back" are cited. I will be no different from those many other candidates. I too feel an obligation to give back to the organization that has given me so much. Since coming to Houston in 2000, I have tried to involve myself in the local and national societies of our geoscience profession. I learned early in my career, that what you get out of an organization is proportional to what you put into it.

My involvement with HGS began by attending the dinner meetings in order to both broaden my geological understanding through technical presentations, and to develop my professional network by associating with my peer group. Soon, I was invited to participate in committee work, and volunteered to raise sponsorship money for the International Committee's excellent African Conferences.

For the past two years, I have had the pleasure of serving on the HGS Board as a Director with oversight of several of our all-important committees. The Board experience has been eye-opening, challenging, and satisfying work. I am standing for the office of President Elect because I wish to continue my service to the HGS membership and believe I can continue to make a positive contribution.

Finally, I encourage all HGS members to get involved. A good first step is to vote. Read the candidate biographies, make an informed decision, then be an active participant and vote. ■

Candidates for the 2014–2015 Executive Board *(continued)*

continued from page 22

Deborah K. Sacrey—*Candidate for President-elect*

Honors and Awards:

1999	HGS Distinguished Service Award
2005	HGS Honorary Membership Award
2011	HGS - Gerald Cooley Awardee
1994	AAPG Meritorious Service Award
2004	AAPG Distinguished Service Award
2011	House Long Service Award (15 years) - AAPG
2004	Certificate of Merit Award – Heritage Publication – DPA
2010	Division of Professional Affairs – Past President's Award
1984	Oklahoma City Chapter Award - SIPES
2007	SIPES Distinguished Service Award

Professional Activities:

Houston Geological Society

2008-11	Technofest Committee Chairman
2004-05	HGS Office Committee Chairman
1997-98	HGS Treasurer
1996-97	HGS Treasurer-Elect
1996-Present	AAPG Delegate – Houston
1995-96	HGS Political Affairs Committee Chairman
1992-96	HGS Public Relations Committee Chairman

Gulf Coast Association of Geological Societies

1999-00	Treasurer – GCAGS – Houston 2000 Convention
1999-02	Finance Committee Member

American Association of Petroleum Geologists

2012-14	AAPG Treasurer
2010-12	Chairman Government Affairs Committee – DPA
2008-Present	Investment Committee member
2007-09	Chairman Washington Advocacy Group for GEO-DC office
2006	AAPG National Convention Co-Vice Chair-2006 Convention
2005	President, Division of Professional Affairs
2005-6	AAPG Advisory Council – Past DPA President
2004-5	President-Elect, Division of Professional Affairs
2003-04	Chairman, ad hoc Credentials Recognition Committee – DPA
2002-04	Chairman Rules and Procedures Committee – House of Delegates
2002-03	DPA Secretary
2002	AAPG National Convention Co-Vice Chair
2001-02	DPA Vice President
2001	Chairman Nomination and Election Committee – House of Delegates
1999-00	Secretary/Editor to House of Delegates
1992-94	AAPG Public Information Committee Chairman

Society of Independent Professional Earth Scientists

2001-02	SIPES National President
2000	General Chairman SIPES National Convention
1999-01	President SIPES National Foundation
1998-99	Vice-President SIPES National Foundation
1997-02	National Director from Houston Chapter
1995-96	Houston Chapter Secretary
1995-97	SIPES Representative to Interdisciplinary Coordinating Council (IDCC)
1993-94	Houston Chapter Treasurer
1983-85	Oklahoma City Chapter Chairman

Statement:

The Houston Geological Society is 3400+ members strong and growing. As the largest geological society in the Western Hemisphere, the HGS is the example other geoscience organizations look to for innovation, creativity and energy amongst its membership. But the world does not stand still, and the HGS needs to constantly strive to bring to the fore new programs, technology and entertainment venues to keep the membership engaged. It is also incumbent upon the leadership of HGS to involve the younger generation of geoscientists in Houston (and elsewhere!) in the development of new ideas for HGS activities. This serves two purposes: 1) the young professionals and Neo Geos are our future, and they have insights as to what will appeal to their generation and the energy to make new programs successful, and 2) this helps develop future leadership for the organization, and creates "members for life" types of attitudes. Currently, the Neo-Geos represent over 15% of the HGS membership, which is huge. We don't have a way of tracking the number of young professionals, but one could assume another 10% of the members.

As a long-time member of the HGS, I am truly honored to be a candidate for the office of President-Elect. If elected, I am hoping to put my efforts and knowledge gained from working in the national arena back into the local Society, and focus on bringing exciting new ventures to the membership (and re-invigorating present programs). ■

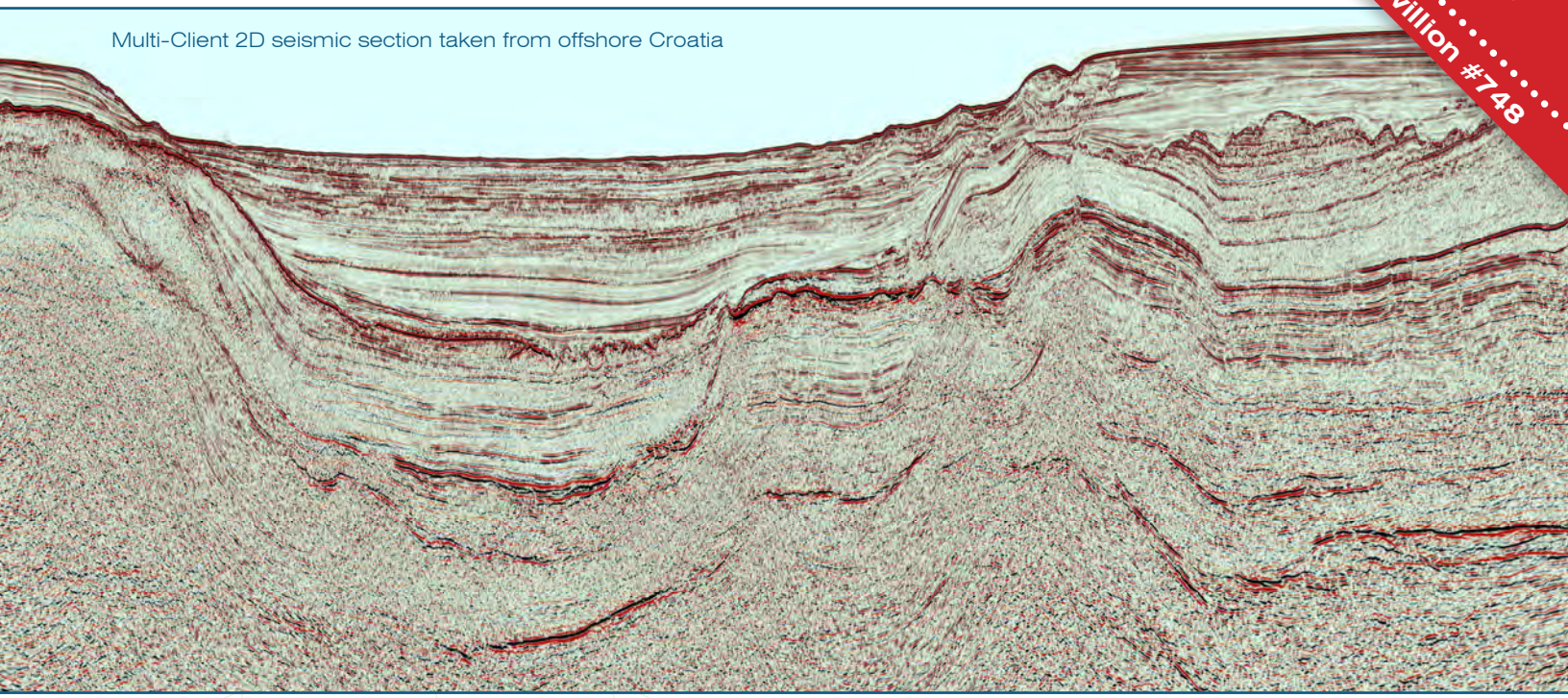
Vote in the HGS election.

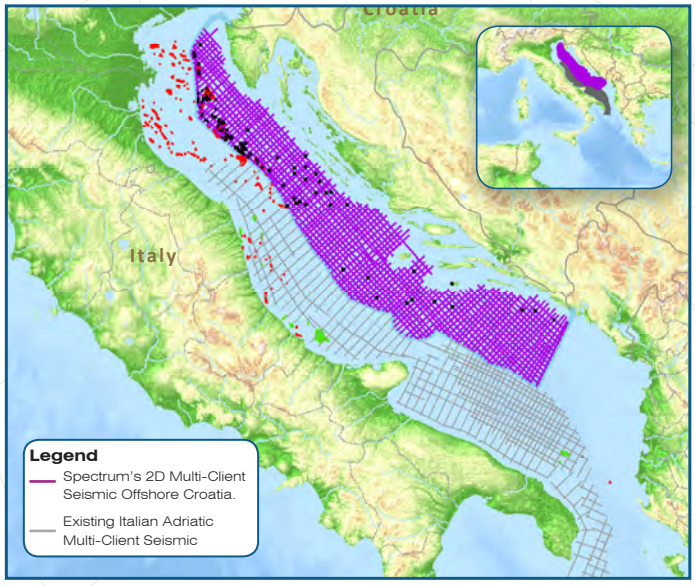
visit us at AAPG Annual Convention booth #1233 and AAPG International Pavillion #748

Offshore Croatia

A New Oil Province at the Heart of Europe

Multi-Client 2D seismic section taken from offshore Croatia





Spectrum has acquired a truly unique Multi-Client seismic survey offshore Croatia. This is the only seismic data available to license in this hugely underexplored region which expects to see its first offshore licensing round this year.

The survey, acquired under contract to the Ministry of the Economy in Croatia, covers approximately 14,700 kilometres of long offset seismic data with a 5 km x 5 km grid. It extends across most of the Croatian Adriatic Sea and connects with Spectrum's reprocessed seismic data covering the Italian Adriatic Sea.

Final PSTM data has now been delivered and all processed data available in early April. The Government of Croatia plans to hold a licensing round over the country's offshore continental shelf in 2014.

Spectrum

+44 (0)1483 730201
mc-uk@spectrumasa.com
www.spectrumasa.com

Candidates for the 2014–2015 Executive Board *(continued)*

continued from page 23

Mike Erpenbeck—*Candidate for Vice President*

to serve my fellow members. I think my relevant industry and Society experience have prepared me well for this potential new challenge. If elected Vice President, I pledge to give my best efforts to continue to discover what Society members at all experience levels desire in their lunch and dinner presentations, and to bring outstanding speakers to these events. I ask your consideration and for your vote for this position. ■

continued from page 23

John E. Jordan —*Candidate for Vice President*

through the high-quality techincal talks and educational programs supported by the strong pool of highly-motivated volunteers.

I would be honored to serve as the Vice President of the Houston Geological Society. I have held several positions in the HGS in the past including Treasurer and Board Member. If elected, I would continue the great tradition of offering timely, quality talks on diverse topics and providing relevent short courses. As an explorationist, I believe I understand the needs of the working geoscientist and would be pleased to serve you as the Vice President of the Houston Geological Society. ■

Wednesday, April 9, 2014

Black Lab Pub, Churchill Room • 4100 Montrose Blvd.

Social 5:30 p.m., Dinner 6:30 p.m.

Cost: $30 Preregistered members; $30 non-members/walk-ups

To guarantee a seat, pre-register on the HGS website & pre-pay by credit card.
Pre-registration without payment will not be accepted.
Walk-ups may pay at the door if extra seats are available.

Mark T. Ford
Assistant Professor [Mark.Ford@tamuk.edu]
Department of Physics and Geosciences
Texas A&M University – Kingsville

Using a Portable X-Ray Fluorescence (pXRF) Spectrometer for Lithogeochemistry Applications: Potential for Volcanic Stratigraphy and Shale Marker Beds

Lithogeochemistry is a method commonly used for mapping and correlating surface exposures of rocks. A new generation of portable X-ray fluorescence spectrometers (pXRF) has the potential to be used for this purpose. Under certain conditions, pXRF analyses can likely be extended to chemostratigraphy of core obtained during hydrocarbon exploration. One shortcoming, however, is that many of the commercially available devices only provide pre-set, often proprietary calibrations, that are suitable only for narrowly restricted uses, typically where the analyses do not have to be compared with commercially available chemical analyses or data gathered with pXRFs of different brands. Use of raw intensity data might provide acceptable correlation in some cases, but the data provide no quantifiable analytical concentration values.

Under certain conditions, pXRF analyses can likely be extended to chemostratigraphy of core obtained during hydrocarbon exploration.

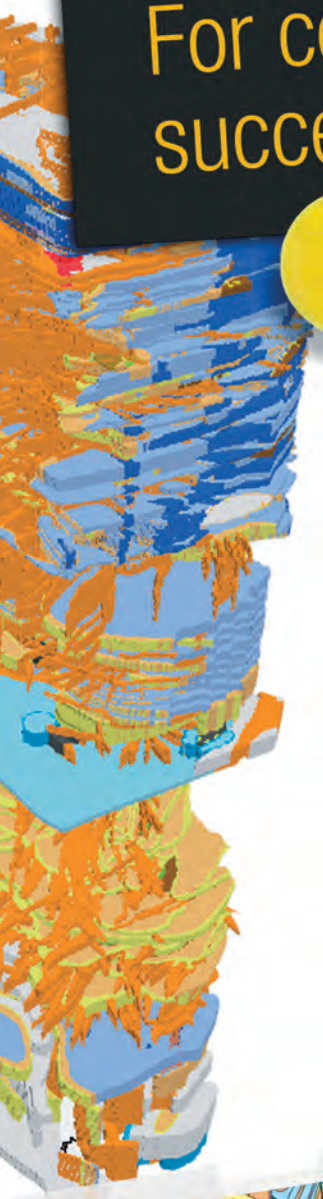
The use of standard pre-set calibrations, which are often based on multi-variate analysis statistics, might show correlation between units, but parameters must be narrowly defined and there must be little to no variation in matrix elements. Even then, some of these calibrations are based on proxy elements and no physical reason supports the calibration corrections. Corrections for these matrix elements (called influence coefficient corrections) can be achieved with some Bruker model pXRFs, whereas users can define their own calibrations and apply these calibrations over a broad range of compositions (within limits). One can obtain concentrations that are reproducible with other, better characterized, methods such as inductively coupled plasma (ICP), Wavelength Dispersive X-ray

Environmental & Engineering Dinner *continued on page 35*

Bruker Tracer IV portable X-ray fluorescence (pXRF) spectrometer

Strongly welded tuff with flattened vitric pumice fragments from Big Bend National Park (Courtesy of the Texas Bureau of Economic Geology)

For comprehensive and successful exploration...



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- Interpret all available well and outcrop data within a globally consistent framework ✓
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- Access a comprehensive organic geochemistry and petroleum fluids database ✓
- Place local biostratigraphic schemes into a regional or global context to improve correlation ✓
- Utilise a high-resolution geodynamic plate model to aid prediction ✓
- Integrate all data in a 3D format for rapid regional assessments ✓
- Integrate with seismic data to create play analyses and prospect generation. ✓

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HGS Environmental & Engineering Dinner continued from page 33

Fluorescence (WDXRF), etc. While much of this work focuses on pumice chemistry and tuff correlation in Big Bend National Park, it should have applications in identifying shale marker beds.

Biographical Sketch

Mark T. Ford is an assistant professor in the Department of Physics and Geosciences at Texas A&M University – Kingsville. He graduated from Alfred University in 1995 with a BA degree in geology and mathematics and then worked in the ceramics industry for Corning Incorporated. He returned to school earning his MS in geology from Idaho State University and a PhD in geology from Oregon State University in 2012. Over much of the past decade he has roamed the high places and "lava plains" of Oregon and Idaho, working on volcanic systems related to the Yellowstone Hotspot, Newberry Volcano, and Cascades Arc. During that time he also worked with a wide array of geoanalytical techniques to characterize the major, trace and isotopic compositions of igneous rocks and to understand better petrogenesis in igneous systems. He began work last year at Texas A&M University – Kingsville where he is expanding his research to include pegmatite mineralization in the Llano Uplift and volcanism in Big Bend National Park. One of the key tools he is utilizing in this research is a portable X-ray fluorescence (pXRF) spectrometer.

Monday, April 28, 2014

Westchase Hilton • 9999 Westheimer
Social Hour 5:30–6:30 p.m.
Dinner 6:30–7:30 p.m.

Cost: $30 Preregistered members; $35 non-members/walk-ups

To guarantee a seat, pre-register on the HGS website & pre-pay by credit card.
Pre-registration without payment will not be accepted.
Walk-ups may pay at the door if extra seats are available.

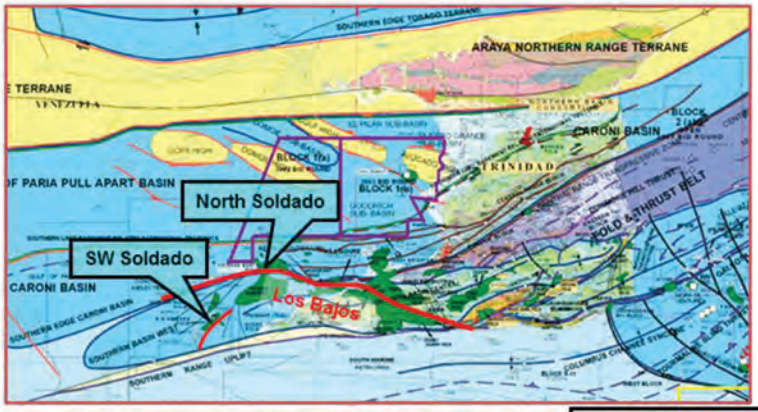
HGS Joint North American and International Dinner Meeting

Steven L. Getz
Geophysical Consultant
Houston, Texas
sgetz@sbcglobal.net

Overpressure-Based Hydrocarbon Exploration for Small to World Class Giant Sized 'Overpressure-Enhanced' Oil and Gas Pools in Cenozoic Sand/Shale Depositional Complexes

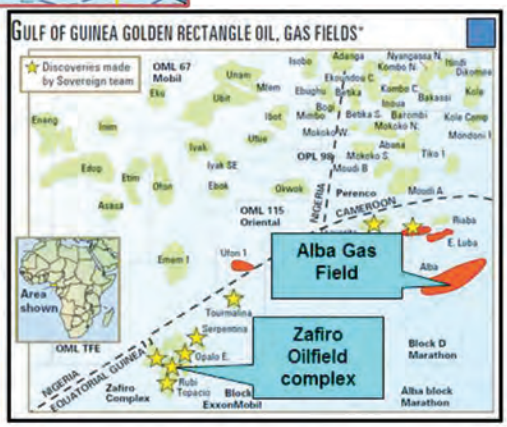
Major oil and gas pools formed along paleo-shelf margins in large sand/shale depositional systems that offlapped divergent continental margins during the Cenozoic, such as the Gulf of Mexico and the Niger Delta petroleum systems. They are often controlled by overpressure-enhanced (OPE) hydrocarbon trap seals. OPE trap seals are also known to exist in Mesozoic sand/shale depositional systems in several foreland basin complexes, such as the one in the Rocky Mountains (e.g., giant Jonah gas field). OPE trap seals occasionally occur in carbonate reservoirs; but, these trapping configurations (which are mostly non-Cenozoic) will not be discussed. This paper follows ground-breaking work done by David Powley, Philip Nelson, Timke, Fertyl & Leach, and others who supplied the foundation for this study.

OPE trap seals in rapidly deposited Cenozoic sediments have been found in petroleum systems that experienced salt deposition (e.g., the Gulf of Mexico basin) as well as in petroleum systems that do not contain salt (e.g., the Niger and East Venezuelan basins). Although OPE hydrocarbon traps have been pursued for decades in the Gulf of Mexico and Niger Basin complexes, their importance has often been overlooked elsewhere. Consequently, OPE traps represent attractive future hydrocarbon exploration targets in many underexplored international basins. OPE hydrocarbon pools vary in size from a few million barrels of oil equivalent (BOE) to world class giants, such as the 1.2 billion BOE Zafiro oilfield complex, pooled in waters offshore Equatorial Guinea.



Taken from: Petroleum Geology & Geochemistry of Trinidad & Tobago: By Krishna M. Persad

Four Large HC Fields Yield Key Lessons in HC Exploration



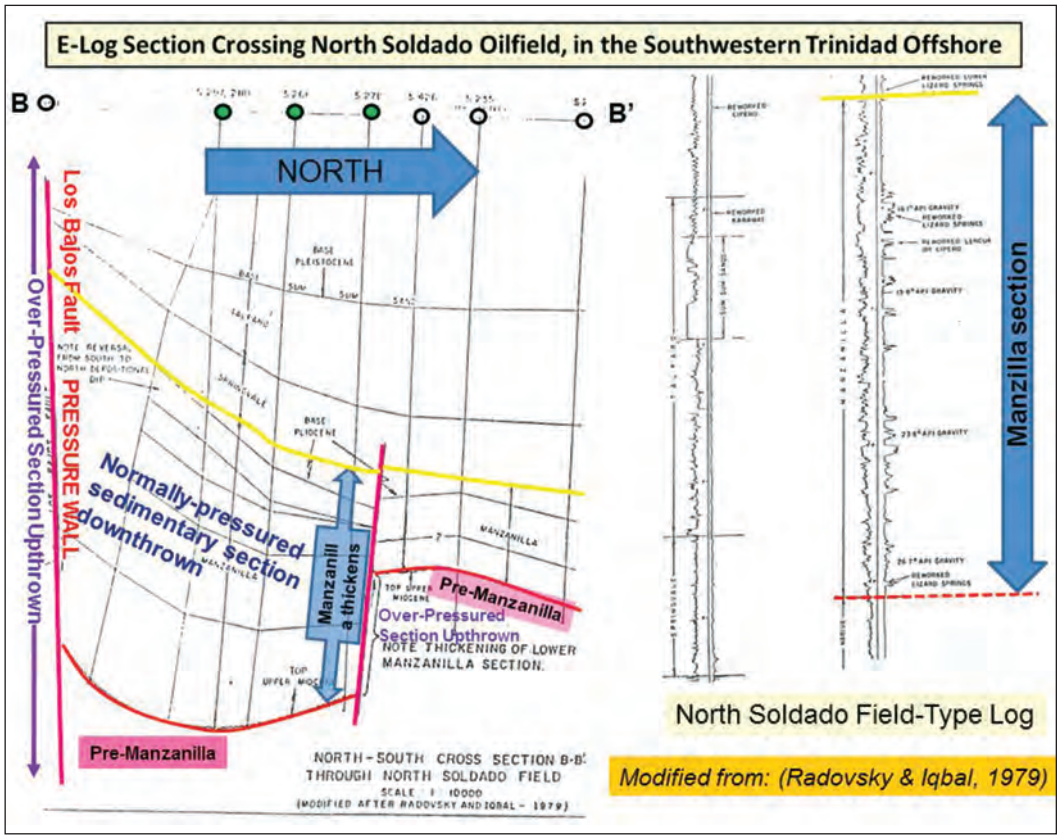
Taken From Bruso, J., Getz, S., & Wallace, R. (February 16, 2004 Oil & Gas Journal)

Most hydrocarbon accumulations in rapidly deposited Cenozoic clastic depositional systems are pooled within 2,000 feet (610 meters) of the top of overpressure in the sedimentary column. However, most OPE oil and gas accumulations occur either just above, or just below, the top of thick overpressured sediments. OPE traps often occur at paleo-shelf margin locations. There, oil and gas fluids have migrated upward via basement-detached 'pressure-relief'

HGS Joint North American and International Dinner

continued on page 39

HGS Joint North American and International Dinner continued from page 37



faults that extend downward through deeper overpressured hydrocarbon source rocks (e.g., Eugene Island 330 oilfield). These pressure release faults probably acted as major hydrocarbon migration conduits that charged many of the large OPE oil and gas fields in the Gulf of Mexico Cenozoic basin complexes. They are exemplified by the giant Eugene Island 330 oilfield offshore Louisiana. This field has produced more oil and gas than reservoir engineers can volumetrically attribute to its isopached reservoir volume, suggesting that active OPE recharging of hydrocarbon reservoirs continued to occur throughout its multi-decade period of oil and gas production.

Transgressive system tract shales often supply the main caprocks for the large OPE accumulations pooled in normally pressured sediments. Shale smears along bounding fault planes or major submarine canyon walls often provide at least one lateral trap seal. OPE shale units can also form main reservoir cap rocks for hydrocarbon pooled in subjacent normally-pressured sediments (e.g., Alba Field, Equatorial Guinea).

Rapid sedimentation downthrown along seaward-focused major syndepositional normal fault systems is almost always involved in OPE petroleum entrapment, especially in areas where these faults detach along down-ramping (and/or up-ramping) salt or shale bedding planes. Most hydrocarbon-bearing OPE traps in sand/shale depositional systems reside in upthrown fault closures, but downthrown OPE faulted nose traps of all sizes have also been found. McPAC field, offshore Texas, as well as Southwest Soldado and North Soldado oilfields, offshore Trinidad & Tobago, are examples of hydrocarbon-filled simple downthrown closures. World class giant anticlinal and/or structural-stratigraphic hydrocarbon pools with OPE seals are also known to exist, such as Zafiro oil field (stratigraphic) and Alba gas condensate field (anticlinal). Both fields were found along the southern margin of the Cenozoic Niger delta in Equatorial Guinean waters.

Syndepositional faults often juxtapose thick sandstone packages against older, sand-poor, slope-shale packages that are significantly overpressured in Cenozoic shelf margin depositional complexes, such as the Orinoco and Niger delta deposystems. At the base of these deltaic sedimentary prisms, toe-thrust faults sometimes create OPE hydrocarbon traps in areas where normally pressured sandstones have been ramped up into overpressured shale units. Toe-thrust faults may also provide the main vertical hydrocarbon migration pathways into some OPE hydrocarbon pools. The world-class Alba gas-condensate field, with an estimated ultimate recovery (EUR) of 2 trillion cubic feet of gas (TCFG) and greater than 400 million barrels of condensate, could be an example of this hydrocarbon charging method.

In some Cenozoic deep-water petroleum systems, lateral hydrocarbon migration appears to have occurred in areas where submarine canyons have incised deeply through contiguous overpressured hydrocarbon source-bearing sediments bracketing the canyon walls (e.g., Edop-Zafiro submarine canyon extending south from the Niger delta platform). Consequently, submarine canyon wall truncation traps should also be considered when exploring for OPE hydrocarbon traps. Compared to hydrocarbon traps enclosed within normally-pressured seals, oil columns in OPE oil and gas traps are usually much longer, which increases the average field EUR (and extraction economics) of overpressure-

HGS Joint North American and International Dinner continued on page 41

At Murphy Oil, Exploration is what drives the company. The company's success has come as a result of a willingness to invest in creative and alternative geological thinking to set us apart from the competition. If you have a strong geosciences background and are looking to make a difference with breakthrough thinking, read on.

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We are expanding our regional capability in Kuala Lumpur to support New Ventures activities in South East Asia. We are seeking talented professionals who are explorers at heart, to work in dynamic teams tasked with play-based regional studies to the evaluation of specific new opportunities. With advanced technologies and software at hand, we seek the most creative and thorough geological minds to join us in achieving the aim of building on our significant success in Malaysia to create the next big hydrocarbon discoveries in SE Asia.

Work, live and play in a vibrant, multicultural city, Kuala Lumpur. Malaysia is known for its eclectic cuisine, pristine beaches and the best diving, trekking and golfing spots in the world. With modern infrastructure and a variety of quality international schools in place, the city is the go to destination for expatriates.

With exploration offices in Ho Chi Minh, Jakarta, Perth, Houston and Calgary, Murphy has the ability to provide you with a rewarding and varied career. Many of the company's leaders rose to their positions from within and have had the opportunity to experience different roles, cultures and lifestyles across our global exploration network.

Murphy provides competitive expatriate compensation packages in a global work environment. If you believe that you have what it takes to make a difference and want to grow your career then please send your CV to **cv_hr@murphyoilcorp.com** along with a few sentences explaining why and how you think you could make a difference.

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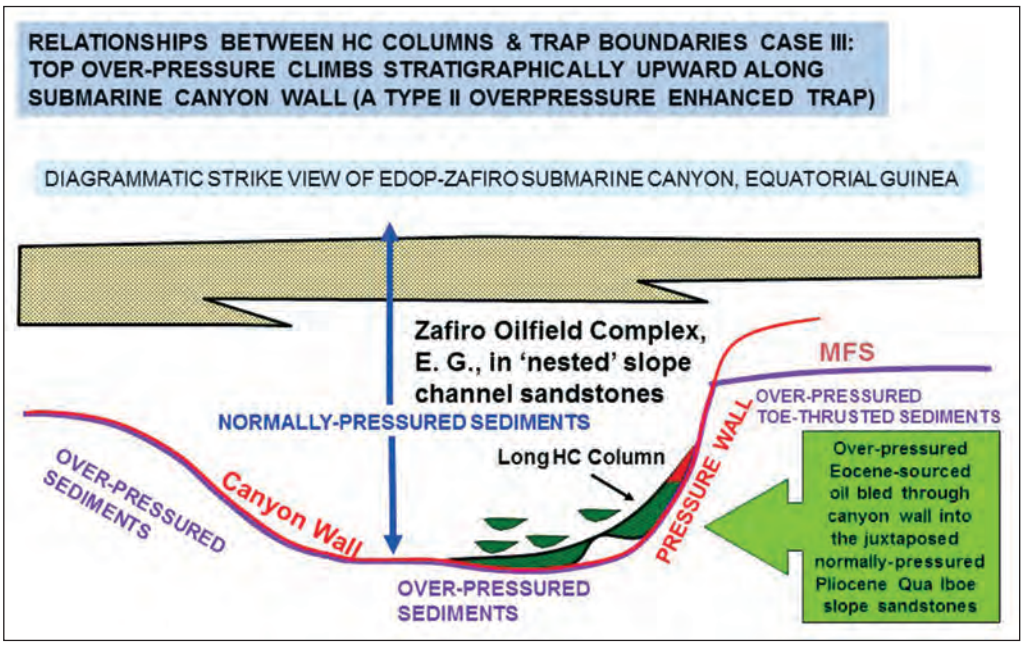
HGS Joint North American and International Dinner continued from page 39



enhanced traps. This occurs because:

1. OPE trap columns often exceed the impingement point of the top of a major sandstone reservoir unit against the landward fault plane,
2. OPE seals (both lateral and vertical) are simply more effective in trapping oil and gas, and
3. Stacked normally-pressured oil and gas pays often develop in a fault block bracketed between a large updip normal fault (that displaces the top of overpressured sediments downward), and a downdip reversed-pressure fault (that displaces the top of overpressured sediments upward). West Chalkley gas field, located in Cameron Parish of South Louisiana, with EUR of 1 TCFG equivalent, probably exhibits this style of hydrocarbon entrapment.

Reversed-pressure faults usually occur where the top of overpressure has jumped stratigraphically upward to a maximum flooding surface located much shallower than the deeper (and thicker) slope sedimentary complexes deposited on the downside of down to the basin normal faults. This causes the basinward-dipping overpressured sediments in the footwall block to overhang normally-pressured sediments in the contiguous upthrown hanging wall in a landward position. Numerous large oil and gas fields in the Gulf of Mexico Tertiary depositional complex exhibit this particular entrapment configuration. This could be because normally-pressured sediments, sandwiched in 'overpressured vises', became the focal point for hydrocarbons migrating up and out of deeper bracketing overpressured cells.

Exploration for OPE hydrocarbon traps can be facilitated by log analysis and subsurface mapping ('hard pressure' mapping). OPE determination via seismic processing and interpretation methods include:

1. Inversion, fault plane polarity analyses, hydrocarbon chimney studies, acoustic impedance and VP/VS ratio studies,
2. Seismic interval velocity studies (including velocity-induced reflection sag analyses), and
3. Attributes, such as seismic 'Bright Spot' and 'Flat Spot' studies, Amplitude Versus Offset (AVO) studies, and absorption studies.

Many of these geophysical methods are applied during the seismic data processing phase. Some are done during the seismic interpretation phase when potential hydrocarbon prospects and lead areas begin to be singled out for further economic analysis and associated de-risking. These combined geophysical methods can essentially deal geoscientists effective 'wild cards' in their ongoing hydrocarbon exploration.

Biographical Sketch

Steven L. Getz is a professional geologist and geophysicist who worked more than nine years with Cities Service Oil Company and then became an oil and gas geoscience consultant for twenty-six years. He has generated prospects that led to large oil and gas discoveries in Equatorial Guinea, Guatemala, and in Trinidad, where he held the title of Chief Geophysicist for Trinmar Limited for two staggered six-month contracts. He has also generated prospects that became commercial oil and gas discoveries in Indonesia, China, the Permian basin, and onshore Gulf of Mexico. From 2005 through 2010, he held the title of Chief Geologist with Allen Hoffman Exploration. Since 2011, he has consulted with Fortesa International on their onshore Senegal acreage, where he has served as their Chief Geophysicist and Exploration Manager of Senegal.

Mr. Getz is currently the Chairman of the AAPG Geophysical Integration Group and the HGS North American Interests Group. He is also an active member of the SEG and is active in the IQEarth field studies group.

HGS - PESGB
13th Conference on African E&P
Africa: A World of Opportunities

September 9-10, 2014

The Westin Houston, Memorial City, 945 Gessner Road, Houston, Texas

Call For Papers, Posters, Sponsors and Exhibitors

In twelve years this conference has become established as a leading technical E&P forum on Africa, with attendance that can exceed 400. Participants include operators, service companies, consultants, governments and academia. The two day program of talks, technical posters and vendors' exhibits will be held on September 9-10, 2014 in Houston, Texas.

The conference, which alternates annually between London and Houston, is organized by the Houston Geological Society (HGS) and Petroleum Exploration Society of Great Britain (PESGB). The HGS-PESGB African Conference covers all aspects of African E&P, with particular emphasis on new ideas for plays and prospects, the geology of the continent and its conjugate margins, and application of emerging technologies.

Abstracts (~200 words) should be submitted as soon as possible but no later than March 15, 2014 to the technical committee, Africa2014@hgs.org. The program will be finalized by the end of April.

Currently, volunteers are being sought to be proactive Session Chairs and anyone interested should contact the Technical Committee as soon as possible.

Details of sponsorship opportunities and display booths are available from the HGS office. To become a sponsor or inquire about exhibit space, contact sandra@hgs.org

Registration will be available from April 2014and Early Bird benefits will apply for a few weeks.

Further details will appear in the HGS and PESGB bulletins and on their websites, www.hgs.org and www.pesgb.org.uk.

Conference Committee for 2014:
Martin Cassidy (chair), Al Danforth, Ian Poyntz, Donna Davis and Sandra Babcock (HGS)
Ray Bate and Duncan Macgregor (PESGB).

Wednesday, April 30, 2014

Petroleum Club • 800 Bell (downtown)
Social 11:15 AM, Luncheon 11:30 AM

Cost: $30 pre-registered members; $35 for non-members/walk-ups; Emeritus/Life/Honorary: $15; Students: FREE

To guarantee a seat, pre-register on the HGS website & pre-pay by credit card. Pre-registration without payment will not be accepted. Walk ups may pay at the door if extra seats are available.

HGS General Luncheon Meeting

Ray Leonard, *CEO*
Hyperdynamics
rleonard@hyperdynamics.com

The New Oil World of the 21st Century

In contrast to the 20th century, which was dominated by conventional production, the first third of the 21st century will see a dramatic shift to unconventional and deep-water production (water depths greater than 400 meters). While new trends have developed since 2000, a close examination of geological, operational, economic, and political factors indicates the possibility that some of these trends may change in the coming years.

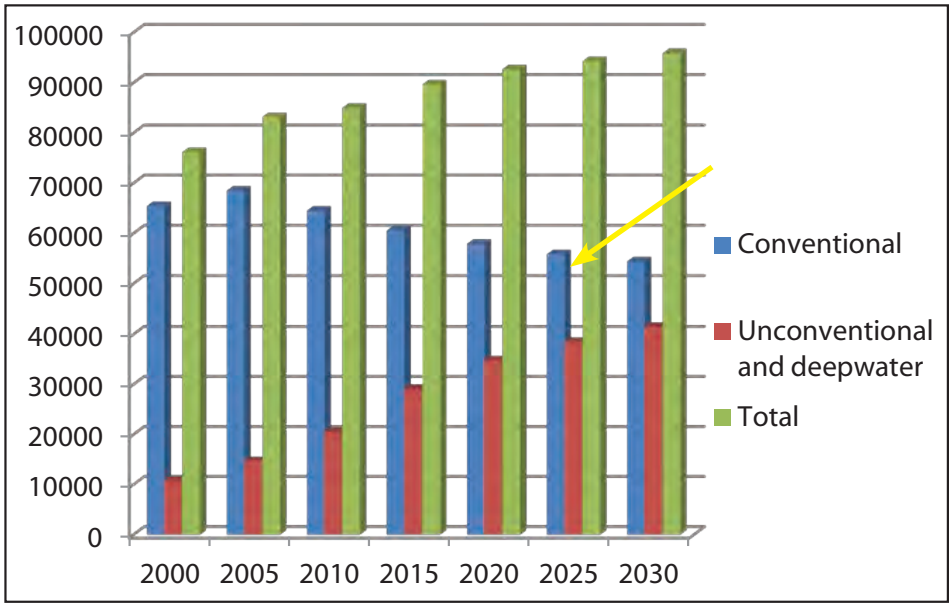


Figure 1. *Non-renewable world oil production continues to rise to almost 96 million barrels per day by 2030, however conventional production peaked in 2005 and falls to about 54 million barrels per day during the same period.*

Conventional production peaked in 2005 at 68 million barrels per day (MMBOD) and has since steadily declined at about 1% per year. However, from the present until 2030, while the rate of decline in the rest of the world continues, the overall production rate from three basins, the Arabian, West Siberian, and Caspian will hold steady and even increase. By 2030, almost two thirds of the world's conventional production will come from these basins which hold about three quarters of the world conventional reserves. The overall proportion of conventional production during the period 2000-2030 is predicted to drop from 86% to 56% of total oil production. The remainder of the non-renewable oil production will come from four sources: deep-water, heavy oil, shale oil, and natural gas liquids.

Deep-water exploration and production are mainly limited to the basins bordering the Atlantic Margin for a number of geologic reasons including: distribution of high-quality source rocks and continuous subsidence and sediment deposition. Approximately three quarters of the deep-water oil predicted to be discovered within the Atlantic Margin will be found in four mega-provinces, mainly due to two differentiating factors: the presence of salt and major river systems supplying sediment. Ultimate deep-water reserves are estimated at 160 billion barrels with peak production between 11 and 12 MMBOD coming in the 2020-2030 decade.

Heavy oil production (heavier than 15 degrees API) is focused in two basins, Alberta and Orinoco, whcih contain 85% of the world's in-place heavy oil. Production has doubled from 2 to 4 MMBOD since 2000 and is predicted to reach 7 MMBOD in 2030. The limit on production, particularly in Canada, is not reserves, but rather water, power resources, and infrastructure and environmental constraints. While heavy oil in Venezuela is superior to Canadian oil and reservoir quality, production is held at a lower level due to non-technical factors, and if this changes, the growth potential for Venezuelan heavy oil production is considerable.

Shale oil has had a major impact on United States production, and is predicted to reach 3.3 MMBOD by 2015, or 5 MMBOD when taking into account natural gas liquid (NGL) production from hydraulic fracturing of gas-prone shales. A significant point of controversy is how long this growth can continue and be sustained due to the sharp productivity decline in the wells. Due to lack of attractive fiscal terms, infrastructure, water resources and environmental concerns, significant production outside the

HGS General Luncheon *continued on page 45*

HGS General Luncheon continued from page 43

United State and Canada is not expected before 2020. The most likely new play outside the United States and Canada for significant shale oil production is the Bazhenov of the West Siberian basin, where most of the non-technical elements are also present.

NGL production is tied to gas production and will steadily rise from about 7.7 MMBOD in 2000 to about 17 MMBOD in 2030 as gas production increases. The rise from the current level of 12 MMBOD will come mainly from three sources: wet gas production from hydraulic fracturing to assist in making shale gas production economical, the shift in gas production in Russia from the dry gas areas to wet gas production areas in West Siberia, and as a by-product of the shift to gas production in the Middle East as a power source.

The peaking of conventional production in 2005 combined with surging demand resulted in an oil price spike and a quadrupling of oil prices (in 2012 dollars) from $25 to $100 per barrel. The new price has supported the rise in the more expensive deep-water and unconventional production. The $100 per barrel price is a windfall for the producers of conventional oil, particularly in the Arabian, Siberian, and Caspian Basins, as they hold an ever increasing share of this production. It is highly unlikely that the price of oil will drop significantly below the current level for more than a very short time, as the conventional producers need $100 oil to balance their budgets and producers of all unconventional and deep-water sources need close to $100 oil to make a profit. This equilibrium should continue until around 2020 when the plateau in the level of deep-water production, coupled with the continued decline in conventional production may result in the next price squeeze. To avoid another price increase, a more rapid rise in heavy and/or shale oil production would be needed, pushing away any environmental constraints or objections or a reduction in the rate of oil demand increase facilitated by a shift to utilization of natural gas. ■

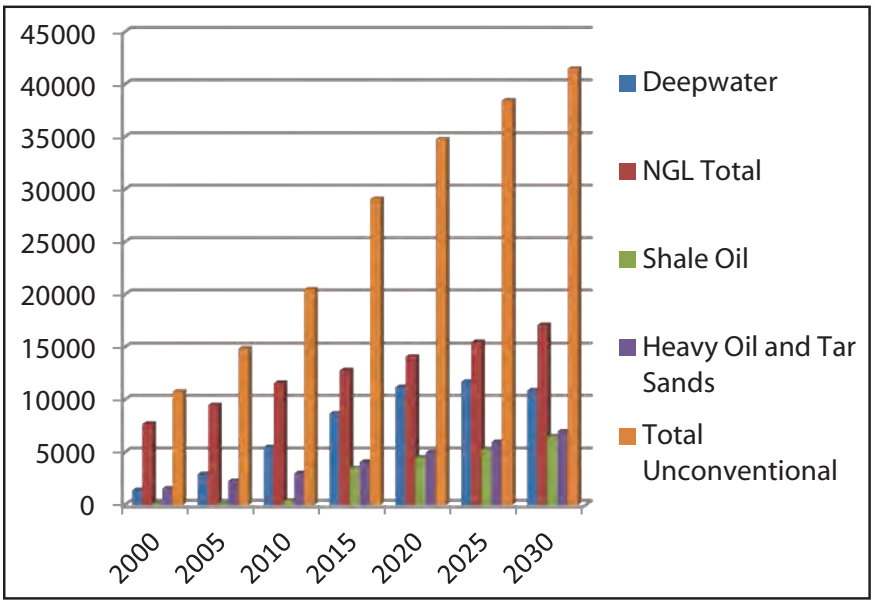


Figure 2. *Unconventional production (including deep-water) increases by about 400% during the 2000-2030 period to more than 40 million barrels per day, or about 44% of total non-renewable oil production.*

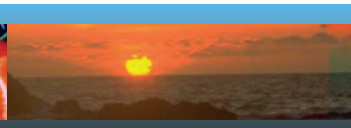
Biographical Sketch

Ray Leonard was born in New York in a family of Ukrainian ancestry. He received a Bachelor of Science in geology from the University of Arizona and a Master of Arts in geology from the University of Texas at Austin. His 19-year career with Amoco was associated with international projects with initial assignments in Trinidad, Norway, and West Africa. In 1989, he was appointed the Director of New Ventures for the Soviet Union, Eastern Europe, and China and in 1995 was appointed Vice President for Resource Acquisitions, Amoco Eurasia. In June 1998, he accepted a position as Exploration Vice President for First International Oil Company (FIOC), a newly-formed company in Almaty, Kazakstan.

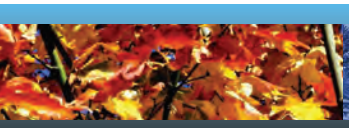
Mr. Leonard accepted a position as Vice President-Exploration and New Ventures in Moscow for YUKOS in January 2001 with responsibility for diversifying the YUKOS upstream portfolio out of the core areas of West Siberia and Samara, specifically to East Siberia, the Russian Shelf, and Central Asia. In January 2005, he joined MOL, the Hungarian National Oil and Gas Company as Senior Vice President for International Exploration and Production. He accepted a position in December 2006 with Kuwait Energy Company, the first Arab private oil company, as Vice President–Eurasia and Exploration. In July 2009, he accepted a position as CEO and President of Hyperdynamics, a company exploring for oil and gas in West Africa. During his four years as CEO of Hyperdynamics, he has built an organization that raised over $200 MM, drilled and operated the first deep-water well offshore Guinea and is now listed on the New York Stock Exchange

He has been active in the debate regarding world oil reserves for many years, presenting and publishing at forums such as Council for Foreign Affairs (1994), Center for Strategic Studies (2001), International Energy Agency (2003), the AAPG Hedberg Conference (2006), the Aspen Forum (2008), and the Emirates Center for Strategic Studies (2011).

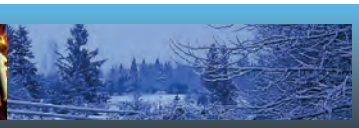
April 2014



Sunday	Monday	Tuesday	Wednesday
	Members Pre-registered Prices: General Dinner Meeting..... $30 Nonmembers & walk-ups..... $35 Env. & Eng. ..... $30 Luncheon Meeting ..... $30 Nonmembers & walk-ups ..... $35 International Explorationists ..... $30 North American Explorationists $30	1 **HGS Board Meeting** *6 p.m.*	2
6 **AAPG Annual Convention & Exhibition** *George R. Brown Convention Center Houston, TX*	7	8 **HGS Night at the Houston Museum of Natural Science** *Houston Museum of Natural Science, Houston, Texas*	9 **HGS Environmental & Engineering Dinner Meeting** *"Using a Portable X-Ray Fluorescence (pXRF) Spectrometer for Lithogeochemistry Applications: Potential for Volcanic Stratigraphy and Shale Marker Beds," Mark T. Ford* *Page 33*
13	14	15 **HGS Northsiders Luncheon Meeting** *Tentative*	16 **AIPG 5th Annual Symposium: Marcellus, Utica, and Point Pleasant Shale: Energy Development and Enhancement** *Columbus, OH*
20	21	22	23
27	28 **HGS Joint International & North American Dinner** *"Overpressure-Based Hydrocarbon Exploration for Small to World Class Giant Sized 'Overpressure-Enhanced' Oil & Gas Pools in Cenozoic Sand/Shale Depositional Complexes," Steven Getz* *Page 37*	29 **AAPG Short Course** *"Petrophysical Analysis and Integrated Approaches to the Study of Carbonate Reservoirs"* *Austin, TX*	30 **HGS General Luncheon Meeting** *"The New Oil World of the 21st Century," Ray Leonard* *Page 43*



GeoEvents



Thursday	Friday	Saturday
3	4	5
	You can make your reservations NOW online at ww.hgs.org	**AAPG-HGS Short Course** *"Introduction to Geohazards Assessment"* *George R. Brown Convention Center*
10 **AAPG Post-Convention Field Trip** *Spindletop Salt Dome*	11	12
17	18	19
24	25	26

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The HGS prefers that you make your reservations on-line through the HGS website at www.hgs.org. If you have no Internet access, you can e-mail reservations@hgs.org, or call the office at 713-463-9476. **Reservations for HGS meetings must be made or cancelled by the date shown on the HGS Website calendar, normally that is 24 hours before hand or on the last business day before the event.** If you make your reservation on the Website or by email, an email confirmation will be sent to you. If you do not receive a confirmation, check with the Webmaster@hgs.org. Once the meals are ordered and name tags and lists are prepared, no more reservations can be added even if they are sent. **No-shows will be billed.**

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Seismological Society of America
2014 Annual Meeting
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2014 Offshore Technology Conference
Houston, Texas

May 6 – 7
TCEQ Environmental Trade Fair and Conference
Austin Convention Center, Austin, Texas

May 12-16, 2013
GeoConvention 2014: Focus Calgary
Alberta, Canada

June 7
HGS Guest Night

June 9-14
Society of Independent Professional Earth Scientists (SIPES) Annual Meeting
New Orleans, LA

June 15-23
HGS Grand Canyon Field Trip

June 28
Annual HGS Skeet Shoot

June 30-July 4
30th International Society for Environmental Geochemistry and Health Meeting
Newcastle-upon-Tyne, UK

A Look Back in Time: HGS Awards and Honors

By Ken Nemeth, HGS President-Elect

Since the HGS Board is considering nominees for its annual recognition awards, I thought that it might be interesting to review them and recount the first announced honorees. HGS honors its members or special contributors who have served the Society with six awards, and this year has created a seventh (which could be combined as below). The Awards are (in ascending honor):

- **Rising Star** – honoring members who are relatively new to HGS and early in their professional career who have made significant and promising contributions to the enhancement and success of the Society. This award was first presented in 1995.
- **Chairman's /Editor** – originally honoring individuals whose extraordinary efforts or unique contributions to the *Bulletin* deserve special recognition. This year's Board has expanded this to include all committees so that committee members who have made significant or long term contributions to the success of their committee can be recognized separate from those receiving the Rising Star Award. The first Editor's Award was presented in 2011. The first Committee Chair Award may be presented in 2014.
- **President's** – honors members whose extraordinary efforts or unique contributions in a fiscal year or over a short period of time deserve special recognition. The first HGS *Bulletin* reported presentation of this award occurred in 1987.
- **Distinguished Service** – honors members who have given long-term valuable service to the Society. These members have distinguished themselves in the science of geology or contributed outstanding service to the success and welfare of HGS. The first reported (HGS Membership Directory) recognition with this award occurred in 1979.
- **Honorary Life Membership** – honors members who have received the Distinguished Service Award and have demonstrated a continued deep and sustained commitment to serving the Society. To better recognize the HGS award hierarchy, the Board (2014) approved making the Distinguished Service award a prerequisite for receiving this award. The first recipient received this recognition in 1937 (HGS Honorary Life Membership Plaque, HGS Office).
- **Gerald A. Cooley** – the 2013-2014 HGS Board recognizes that this award is not only the highest recognition given by the Society, but has evolved into its career achievement award. Honorary Life Membership is now a prerequisite for this award (2014). Gerald Cooley received the first Award in October 1998.

So who were the first recipients of these awards? What are they doing now? Award citations don't always exist in the HGS *Bulletin*s (available online to members back to September 1958). The first *Bulletin* publication of award recognition found by the author was in 1980. The HGS 2011 online Directory noted that the first year provided for awards was 1979. As stated previously, the first Honorary Life Membership was dated 1937 as recorded on the plaque in the HGS office. The author could not find any details regarding this in the available records at the HGS office.

The first recipient(s) include:

- **Gerald A. Cooley** - ***Gerald Cooley***, 1998; deceased.
- **Honorary Life Membership** – ***Wallace E Pratt***, 1937; deceased. (The list of early Honorary Life Members and Presidents for the Houston Geological Society comprise a Who's Who for AAPG!)
- **Distinguished Service** – ***James O. Lewis, Jr.*** 1979; deceased (recorded in HGS/GSH membership directories)
- **President's** – this award was first presented in 1987 to five recipients. There were no citations for them. The first *Bulletin* citations for this award found by the author were in the June 1990 *Bulletin.*
  - ***David M. Eggleston*** – deceased, July, 1987.
  - ***Clyde E. Harrison*** – received Honorary Life Membership (1991); deceased.
  - ***John Hefner*** – received Distinguished Service (1988), Honorary Life Membership (1995), second Gerald A. Cooley recipient (1999); deceased.
  - ***Richard R. McLeod*** – received Honorary Life Membership (1991); no record in 2014 directory; last known location, Kingwood (2011 HGS Directory).
  - ***John W. Sauri*** – Current HGS member, consulting geologist, Houston.
- **Editor Award** – ***Lisa Krueger***, 2011; still doing the *Bulletin* for HGS!
- **Chairman's** – To be determined.
- **Rising Star** – This award was first presented in 1995 to two recipients. Their pictures appear in the September 1995 *Bulletin.* They have not been listed previously as recipients for this award in the HGS Directories.
  - ***Dana Morgan*** – no entry in online directories (2004, 2008, 2011, 2014).
  - ***Linda Sternbach*** – received President's Award (2003, 2013), Distinguished Service (2005), Honorary Life Membership (2011). If you attend HGS general dinner meetings, you have seen Linda videoing our speakers. In her spare time, Linda is chairing the 2014 HGS committee for the HGS Night at the Paleontology Museum during the AAPG convention.

So John, Richard, and Dana, what are you up to these days? To all HGS honorees, thank you for giving so generously of your time throughout your careers. ■

Fundamental Principles of Hydrocarbon Formation, Migration and Accumulation

by ***Arthur S. Dickinson,*** *Geological Engineer, Surfside Energy, LLC*
arthur.s.dickinson@gmail.com

Foreword

Have you ever drilled a well on a structural "high" that had no accumulation? Or have you ever drilled a well that had "lots of shows," but no commercial production? This paper may explain why.

Premise

It is reasonable to conclude that hydrocarbons form and begin to migrate and accumulate soon after the organic matter, from which the hydrocarbons are derived, is buried with the sediments that constitute both the source shale and the reservoir sand.

In a water-saturated subsurface environment, all sand grains and particles of shale are coated with a thin film of water called interstitial water.

When we accept this premise as the foundation of our thinking about hydrocarbon formation, migration, and accumulation, we are challenged to learn more about the subsurface environment and the forces at work in this environment that cause widely scattered hydrocarbons to migrate and accumulate. These forces are as follows: surface tension (capillary), buoyancy, and timing.

Background

From a chemistry lab in high school or in college, you may recall, when we filled a tall glass beaker with water, that the half-moon curved surface at the top of the water column was called a meniscus. This meniscus surface is concave downward along the inside of the glass beaker because of the attraction of the water for the glass. This attraction of the water for the glass is caused by surface tension or capillarity. The same phenomenon is at work in the subsurface. All porous rocks in the sedimentary section below the water table are saturated with water. Hydrocarbons are the "strangers" in this water-wet environment and initially may have been widely scattered as minute globules of oil or bubbles of gas. So, what causes these widely-scattered hydrocarbons to migrate and accumulate?

Surface Tension (Capillarity)

In a water-saturated subsurface environment, all sand grains and particles of shale are coated with a thin film of water called interstitial water. This interstitial water isolates these grains of sand or particles of shale from any direct contact with the hydrocarbons. Because a fine-grained shale bed has more surfaces for the interstitial water to attach to than a coarse-grained reservoir material, most of the available space in the shale bed is occupied by interstitial water. This tends to force any existing globule of oil or bubble of gas out of the fine-grained shale into the coarse-grained reservoir material. In fact, laboratory experiments have shown that this surface tension interaction between a fine-grained shale section and a coarse-grained reservoir material is so powerful that hydrocarbons in an over-lying shale bed tend to be forced downward into the reservoir bed against the upward force of buoyancy acting on the hydrocarbons.

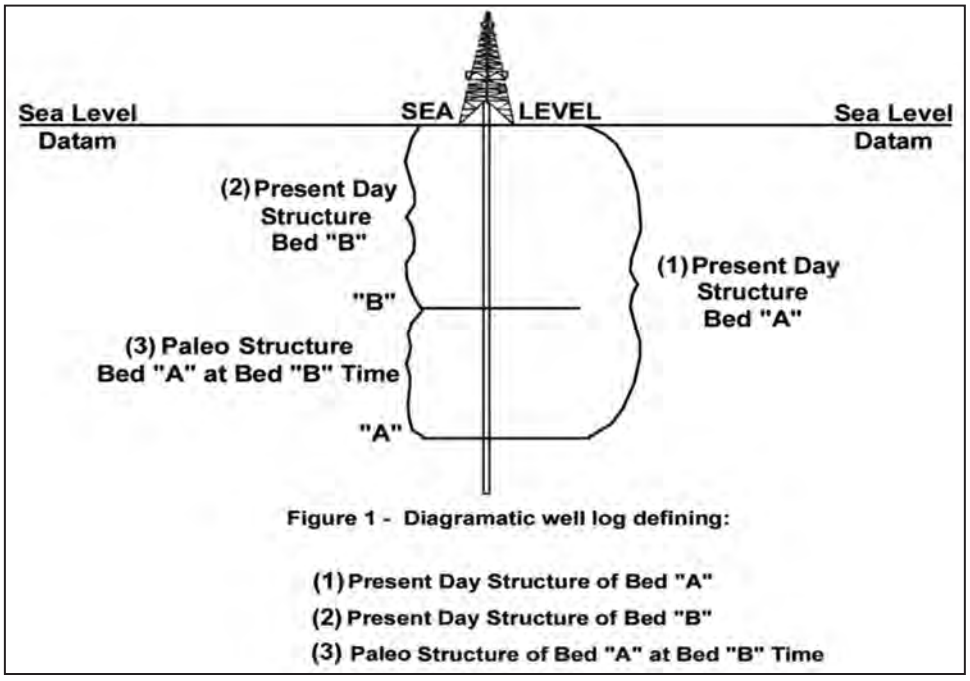


Figure 1. These three mapping intervals are uniquely related. If we have accurately mapped any two of the three intervals, we can accurately map the third interval by overlaying the two existing maps on each other and contouring through intersecting points of equal value.

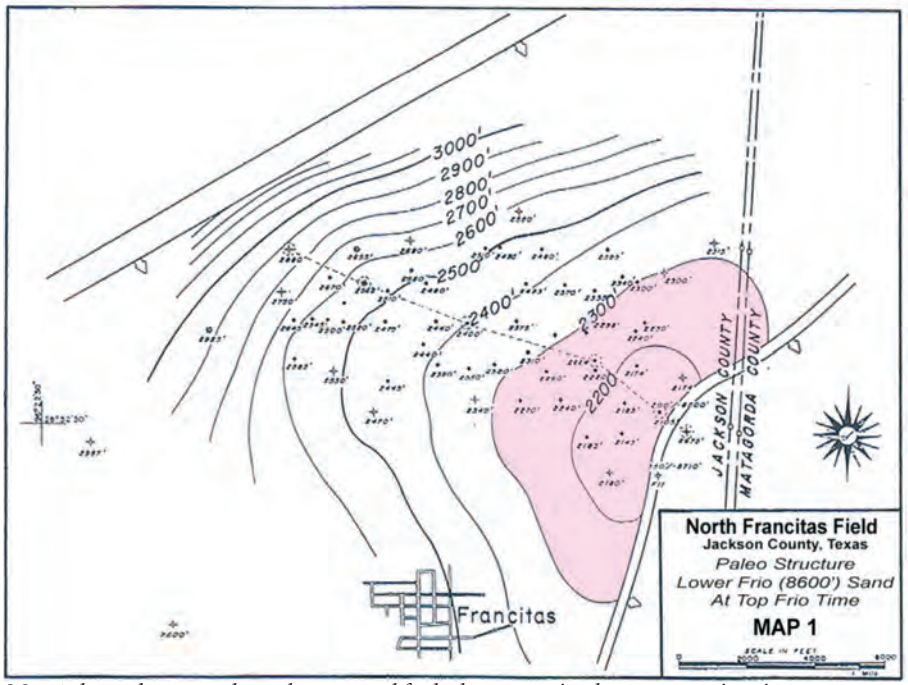
Buoyancy

Once in the reservoir bed, hydrocarbons are primarily affected by buoyancy which is caused by the difference in specific gravity between the hydrocarbons and the

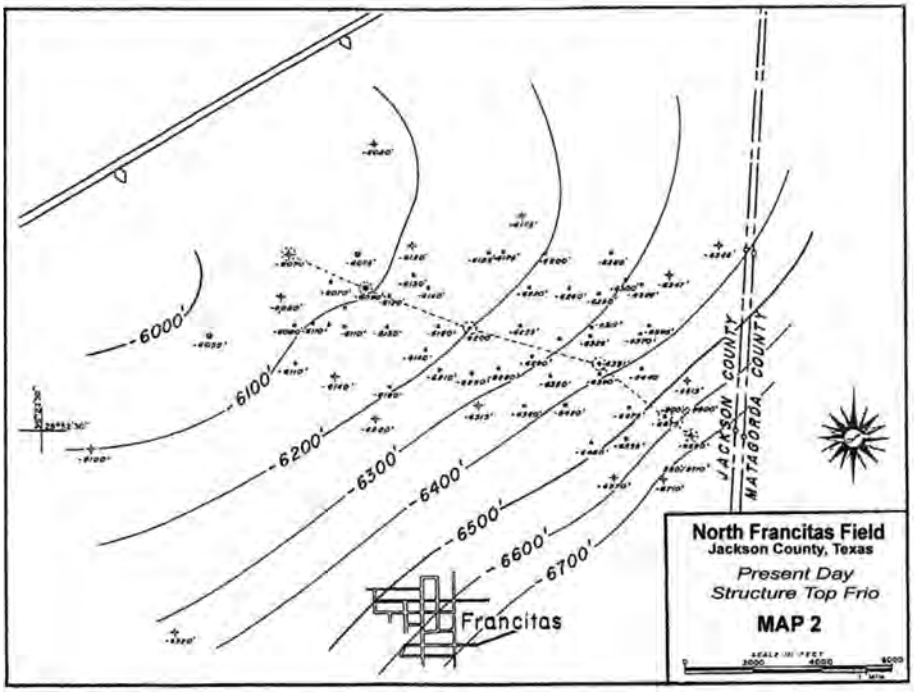
Fundamental Principles Of Hydrocarbon Formation *continued on page 53*

Fundamental Principles of Hydrocarbon Formation *continued from page 51*

water. Water normally has a specific gravity of approximately 1.00 gram per cubic centimeter. If oil has a specific gravity of 0.85 grams per cubic centimeter and gas a specific gravity of 0.35 grams per cubic centimeter, the lighter hydrocarbons tend to move vertically upward in the reservoir bed until they encounter the permeability barrier at the base of the shale section caused by the difference in grain sizes between the coarse-grained reservoir bed and the fine-grained overlying shale. Because the hydrocarbons are prevented from re-entering the overlying shale bed by the permeability barrier, these migrating hydrocarbons then tend to move "up-dip" in the reservoir bed until they are either trapped in the subsurface or escape at the surface.



Map 1 shows that a nearby early structural fault closure was in place to trap migrating hydrocarbons in the objective Lower Frio (8600') Sand during the critical time of the initial hydrocarbon migration.



Map 2 shows the later structural tilting of the Lower Frio (8600') Sand that moved the crest of the initial fault closure about one mile NW to its present-day site as a 4-way dipping anticlinal closure.

Timing

The earth's crust tends to move and adjust over geologic time. Therefore, it is critical that we have a structural mapping method to cope with these structural adjustments of the earth's crust. We need to know that a trap existed in the objective reservoir bed at the critical time of the initial hydrocarbon migration, and we also need to know the effect of later structural tilting that may have moved the initial accumulation to another place. The stage is now set to apply Paleo Structural Analysis to find out if a trap existed in the objective reservoir sand at the critical time of the initial hydrocarbon migration and to determine the effect of later structural tilting that may have moved the initial accumulation to another place.

Application of Paleo Structural Analysis

The term "Paleo Structural Analysis" is familiar to most Gulf Coast geologists who realize that it is a way of thinking about the use of structural mapping intervals to restore the structural growth history of a developing trap for hydrocarbons. "Paleo Structure" is a meaningful term because it tends to put proper emphasis on the "old structure" of the objective reservoir bed that existed at the time of the initial hydrocarbon migration. Paleo Structural Analysis implies that a map of the interval from lower Bed "A" to upper Bed "B" represents the structure of lower Bed "A" at the time upper Bed "B" was deposited. This concept is based on the relatively safe assumption that upper Bed "B" was either deposited at sea level or on a horizontal surface parallel to sea level.

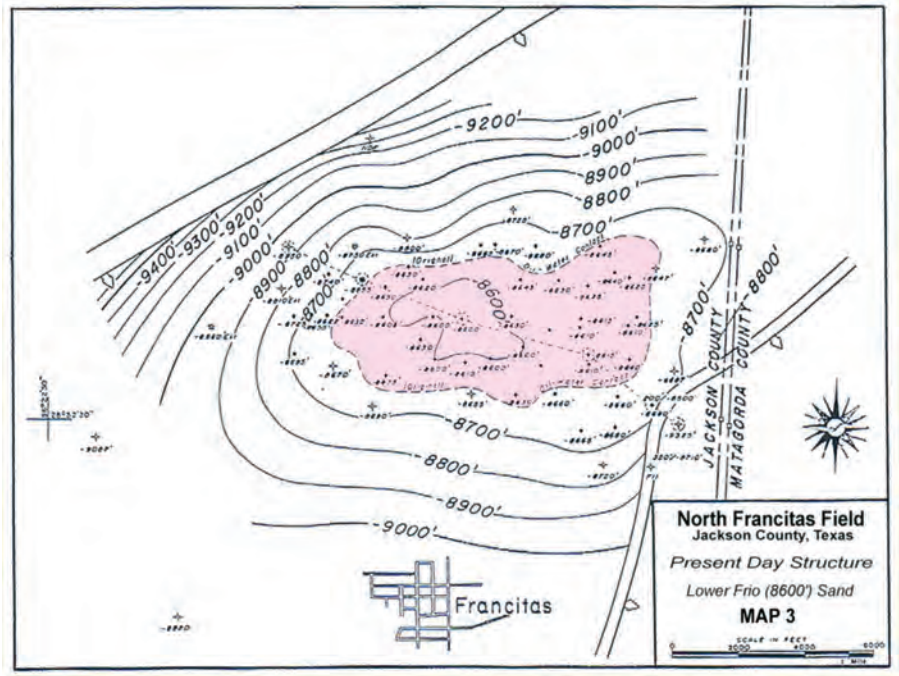
Fundamental Principles Of Hydrocarbon Formation *continued on page 55*

Fundamental Principles of Hydrocarbon Formation

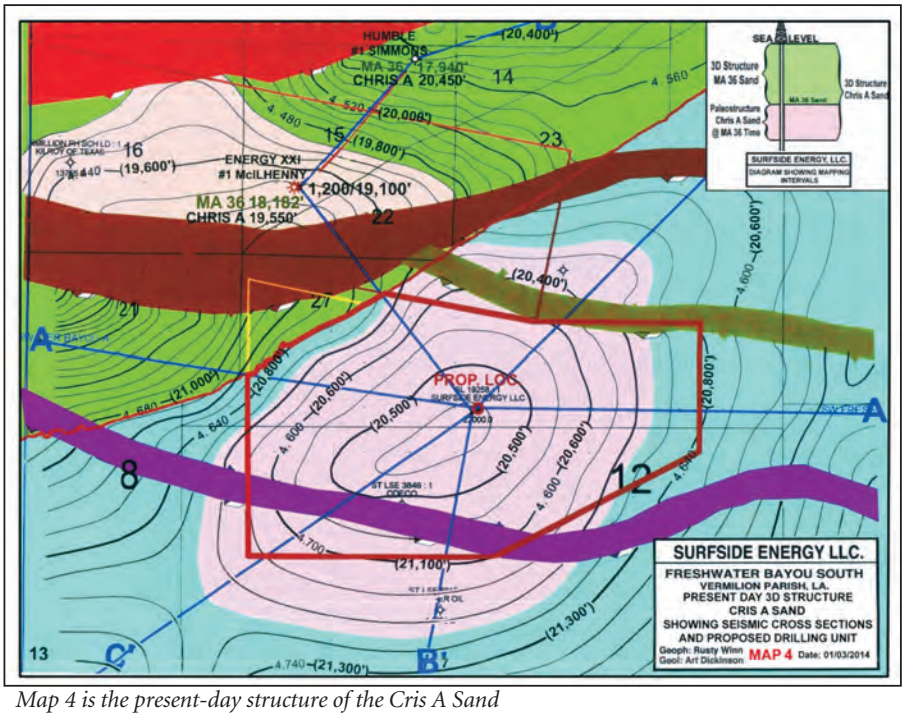
continued from page 53

The North Francitias Field, Jackson County, Texas

The North Francitas Field in Jackson County, Texas provides a good example of the use of Paleo Structural Analysis to acquire a better understanding of the importance of the timing of the initial accumulation and the effect of the later structural tilting that may have moved the initial accumulation to another place.



Map 3 is the present-day structure of the Lower Frio (8600') Sand.



Map 4 is the present-day structure of the Cris A Sand

Using Paleo Structural Analysis to Reduce Drilling Risk

In 2010, Surfside Energy LLC acquired a license to 16.8897 square miles of 3D seismic data from WesternGeco of the Freshwater Bayou South area in offshore state waters, Vermilion Parish, Louisiana. Interpretation of these data revealed a 4-way dipping structural closure at a depth of approximately 20,450 feet at the top of the lower Miocene Cris A Sand section. The shallower MA 36 Sand at approximately 18,150 feet was also mapped. We needed to know if a trap existed in the objective Cris A Sand at the time of the initial hydrocarbon migration and we also needed to know the effect of the later structural tilting of the Cris A Sand that may have moved the initial accumulation to another place.

The map to determine if a trap existed in the Cris A Sand during the critical time of the initial hydrocarbon migration is the map of the paleo structure of the Cris A Sand at MA 36 Sand time. This map was derived by overlaying the map of the present-day structure of the Cris A Sand (Map 4) on the map of the present day structure of the MA 36 Sand (Map 5) and contouring through intersecting points of equal value. The resulting map shows the paleo structure of the Cris A Sand at MA 36 Sand time (Map 6) as a 4-way dipping structural closure that would have trapped migrating hydrocarbons during the critical time of the initial hydrocarbon migration.

Converting Interval Thickness to Geological Time

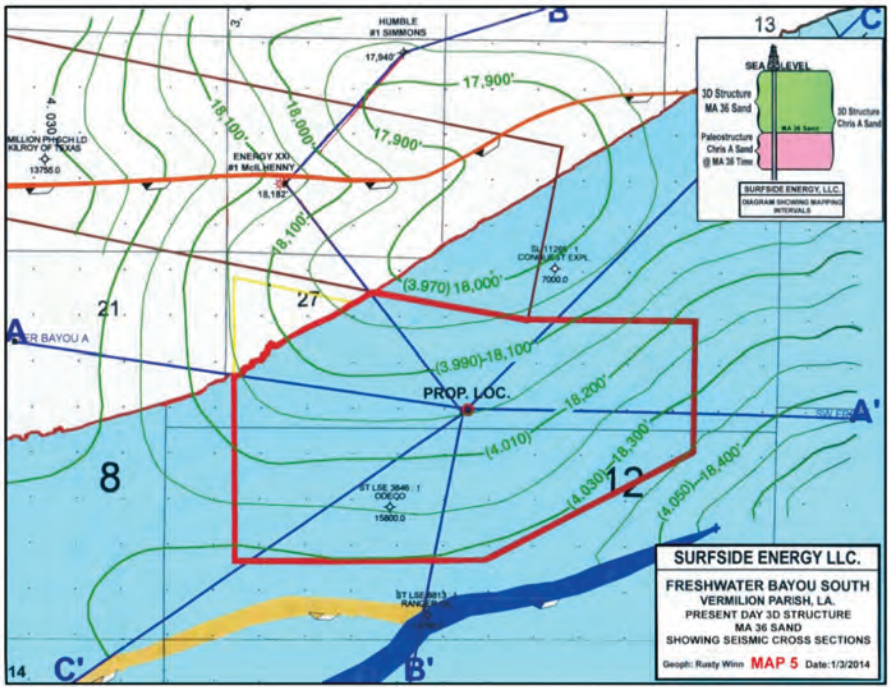
Freshwater Bayou South is regionally located within a lower Miocene rapid depositional area where the average rate of deposition was approximately 1,000 feet per million years. Note on the map of the paleo structure of the Cris A Sand at MA 36 Sand time (Map 6) that the 2,300-foot contour goes through the proposed drill site. This 2,300-foot interval is the thickness of the section immediately above the objective Cris A Sand, which converts to 2.3 million years of lapsed geologic time immediately following the deposition of the Cris A Sand. This was ample time for the hydrocarbons in the Cris A Sand to have formed, migrated,

continued on page 57

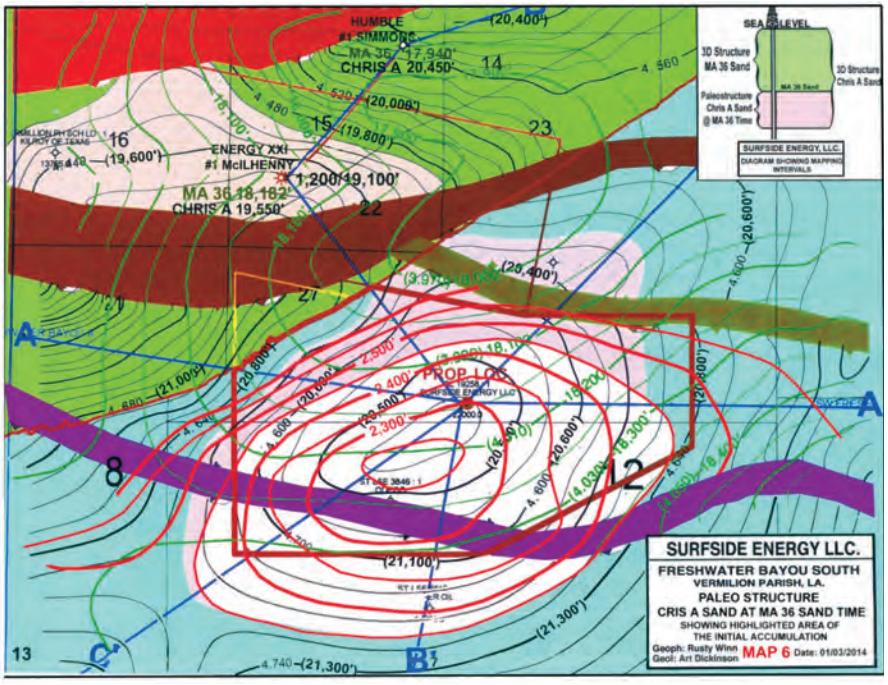
Fundamental Principles of Hydrocarbon Formation

continued from page 55

and to have initially accumulated. Also note that the 20,450-foot contour of the present-day structure of the Cris A Sand (Map 4) goes through the proposed drill site and that the 18,150-foot contour of the present-day structure of the MA 36 Sand (Map 5) also goes through the proposed drill site. The map of the paleo structure of the Cris A Sand at MA 36 Sand time (Map 6) was derived by subtracting the contour values shown on Map 5 from the contour values shown on Map 4. For example, at the drill site: (20,450' – 18,150' = 2300').



Map 5 is the later structural tilting of the 20,450-foot Cris A Sand that moved the initial accumulation (Map 6) to its present-day site (Map 4).



Map 6 is the Paleo Structure of the Cris A Sand at MA 36 Sand time showing the highlighted area of the initial accumulation.

Projected Size and Thickness of the 20,450-Foot Cris A Sand Pile

The 4-way dipping structural closure of the Cris A Sand at 20,450 feet is located downthrown to a large fault that was contemporaneous with the time of deposition of the Cris A Sand section. This implies that an escarpment existed at Cris A Sand time over which sediments tended to pile up on the downthrown side of the fault in the deeper, slower-moving water. As these sediments settled to the bottom on the downthrown side of the fault, the flaky shale tended to be winnowed out, leaving a 20,450-foot Cris A Sand pile close to the downthrown side of the fault. Evidence of the existence and thickness of the 20,450-foot Cris A Sand pile is implied by the high amplitude of the seismic reflection of the 20,450-foot Cris A Sand on Line B-B' close to the downthrown side of the fault. The size and limits of the 20,450-foot Cris A Sand pile on the downthrown side of the fault are implied by the area covered by the high-amplitude reflection on each of the three seismic lines. This high-amplitude reflection is present on each of the three lines over the crest of the structural closure but is missing on the south end of Line B-B', on the east end of Line A-A', and on the southwest end of Line C-C'. Using these observations, the projected size and thickness of the 20,450-foot Cris A Sand pile is shown on the map of the 3D Structure showing the anticipated thickness of the Cris A Sand (Map 7).

Conclusion

Using Paleo Structural Analysis tends to reduce drilling risk because it provides a logical way to determine if a trap existed in the objective reservoir sand during the critical time of the initial hydrocarbon migration and it also provides a logical way to determine the effect of the later structural

continued on page 59

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Deepwater Siliciclastic Reservoirs Field Seminar	April 11-16, 2014 California
Basic Well Log Analysis	April 28-May 2, 2014 Austin, TX
Petrophysical Analysis and Integrated Approaches to the Study of Carbonate Reservoirs	April 29-May 1, 2014 Austin, TX

FIELD SEMINARS

Play Concepts and Controls on Porosity in Carbonate Reservoir Analogs	June 1-6, 2014 Spain
Northern Appalachian Basin Faults, Fractures andTectonics and Their Effects on the Utica, Geneseo and Marcellus Black Shales	June 23-27, 2014 New York
Canoeing with Lewis & Clark: A Geologic Excursion along the Missouri River in Montana	July 14-19, 2014 Montana
Seismic Interpretation in Fold-and-Thrust Belts: Field Trip to the Southern Canadian Rocky Mountain Foreland	July 20-26, 2014 Alberta, Canada

SHORT COURSES

Basic Well Log Analysis	July 28-August 1, 2014 Golden, CO

ONLINE COURSES

E-Symposium: The Gulf of Mexico Basin: New Science and Emerging Deepwater Plays	May 22, 2014 2:00 p.m. CDT
Introduction to Shale Gas – Certificate Course	Ongoing
Unconventional Resources – Certificate Course	Ongoing
Giant Oil and Gas Fields – Certificate Course	Ongoing

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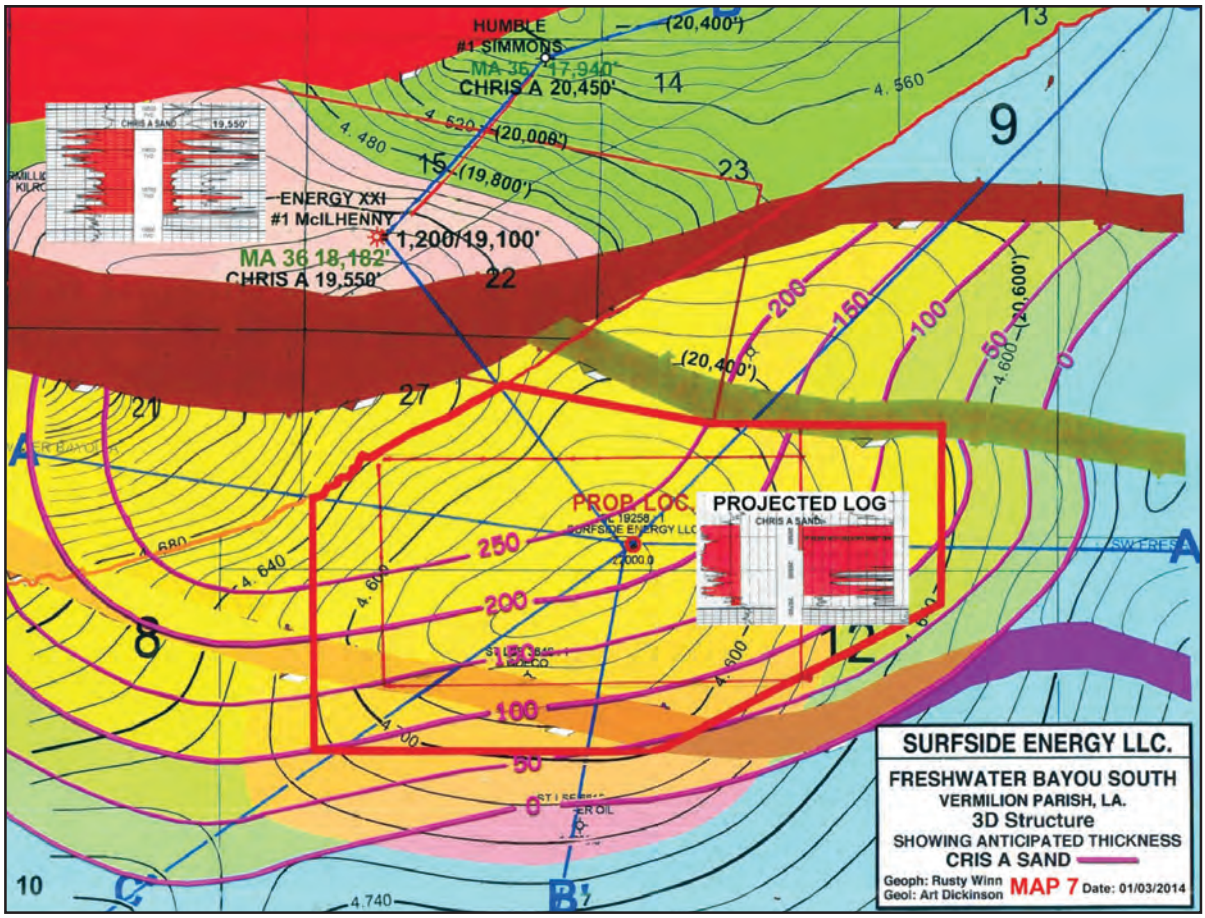
AAPG Education

Fundamental Principles of Hydrocarbon Formation

continued from page 57



Map 7. 3D Structure showing the anticipated thickness of the Cris A Sand.

tilting that may have moved the initial accumulation to another place. ■

Availability of 3D Seismic Data

The 3D seismic data are available for review subject to Surfside Energy's contract with WesternGeco, which requires that a confidentiality agreement be executed before viewing the data. To review the Confidentiality Agreement, contact Art Dickinson at 713-419-0176.

Acknowledgements

The author acknowledges Thomas W. Rollins, co-owner of Surfside Energy LLC, for his encouragement and approval for the author to publish this paper The author also acknowledges Rusty Winn for his work in interpreting the 3D data and also thanks and acknowledges Carol Dickinson for her graphics work in preparing all the exhibits included in this article.

References

Dickinson, Arthur S., 1966, Paleo-Structural Analysis and Application of Later Structural Tilting, Transactions, Gulf Coast Assoc. Geol Soc., Vol XVI, pp 211-217.

Chopra, Salinder and Kumar Sharma, Ritesh, 2013, An 'Elastic Impedance' Approach, *AAPG Explorer*.

Biographical Sketch

Art Dickinson is a graduate of the Colorado School of Mines with the degree in geological engineering. While with Shell, he was intrigued with the concept of structural mapping advocated by Dr. Walter Adkins, a Shell geologist. Doc Adkins recommended mapping a 1,500-foot interval of the section immediately above the objective reservoir sand to determine if a trap existed in the objective sand at that time, but he did not take into account the effect of the later structural tilting. By combining Doc Adkin's concept with the application of the later structural tilting, Mr. Dickinson and his associates were responsible for discovering the following oil and gas fields: Manor Lake Field, Brazoria County, TX, El Maton Field, Matagorda County, TX, West Lucky Field, Matagorda County, TX, Henry Belitz Field, Dewitt County, TX, North Deep Lake Field, Cameron Parish, LA, and the extension of the South Mermentau Field, Acadia Perish, LA.

Vintage Geology

by Michael F. Forlenza, P.G.

A Tasting of Geologically-Themed Wines

Black Slate 2011
Catalonia, Garnacha, and Llicorella

Bodegas Mas Alta S.A.
La Vilella Alta
VI de la Vila
Priorat D.O.Q.
Espana - Tarrogna

14.5 % Alcohol
$24.99 Retail

This month's oenological-geological adventure takes us to Catalonia in northeastern Spain. Bordering France and the Mediterranean Sea, this rugged region is the source of the red wine blend from the vineyards of Bodegas Mas Alta called Black Slate. The Bodegas Mas Alta vineyards lie outside the small village of La Vilella Alta in the designated Priorat wine-making region.

The Wine

Black Slate 2011 is a blend of the grape varietals Garnacha (60%), Carignan (35%), and Cabernet Sauvignon (5%) that spent 12 months in French oak barrels. Garnacha, known as Grenache in France, probably originated in Spain in the region of Aragon and is one of the most widely planted varietals in the world. Garnacha, a late-ripening grape requiring a long growing season, is best suited to hot, dry conditions such as are found around the Mediterranean. Garancha prefers well-drained soil but it is relatively adaptable. In southern France, Garnacha thrives on schist and granite stoney soils where it is the prime varietal for Châteauneuf-du-Pape. Because the grapes tend to lack acid, tannin, and strong color, Garnacha is usually blended with other darker red varieties.

Carignan vines are widely planted throughout the western Mediterranean. Ampelographers believe that the rustic Carignan grape is likely a very old variety based on its widespread plantings and the proliferation of numerous different synonyms indicating a long history in different wine regions. In winemaking, the grape is often used as component in blends for its deep purple color, naturally high acidity, supple tannins, and astringency.

The Black Slate 2011 label describes the winery's vineyards as, "situated on steep slopes of slates alongside of what was once the river of Ecaladei. The heat of south facing vineyards combine with cooler north facing parcels to create a well balanced wine with ripe fruit and softness." And more colorfully, "sun scorched vines cling to breathtaking steep hillsides with their roots deeply plunged in the slate soil of this ancient region." **Vintage Geology** *continued on page 63*

Location of Priorat in Northeaster Spain

Black slate and llicorella soils

Based in the traditional village of La Vilella Alta, Bodegas Mas Alta winery is the work of five Belgian partners' with a common desire to produce a great wine. Winemakers Michel Tardieu and Philippe Cambie planted 35 hectares of vines on the steep slate-covered hillsides for their production. The winemakers also use fruit from older vines located in vineyards throughout the area.

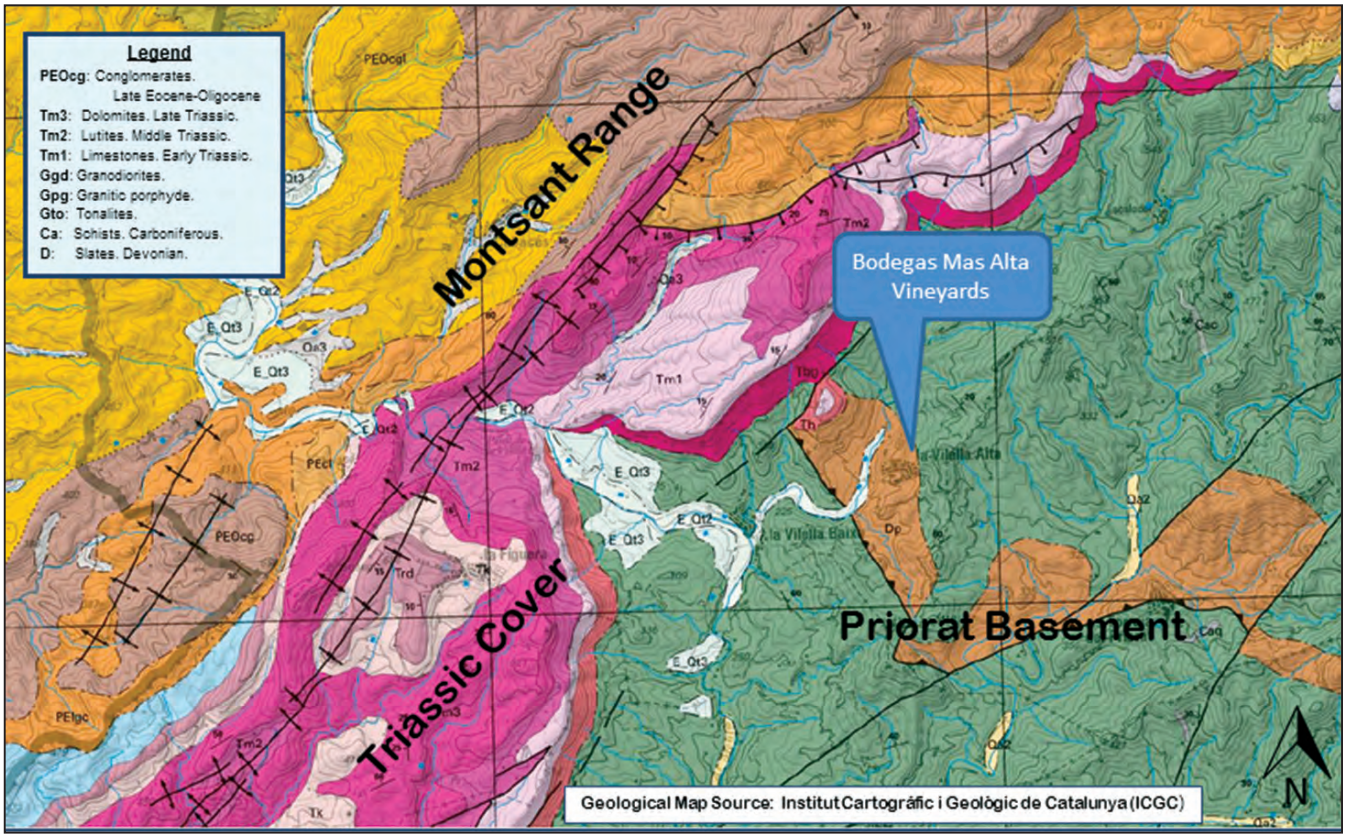
The Region

The Bodegas Mas Alta vineyards are within the designed winegrowing region in Catalonia called Priorat. Priortat is a DOQ, a Denominació d'Origen Qualificada or a Qualified Designation of Origin, as registered by the Spanish Ministry of Agriculture, Fisheries and Food. Priorat is the Catalan spelling, which is the one usually appearing on wine labels, while the Spanish spelling is Priorato. This is one of only two wine regions in Spain to qualify as DOCa, the highest qualification level for a wine region according to Spanish wine regulations, alongside the Rioja DOCa.

The first recorded evidence of grape growing and wine production in the region dates from the 12th century, when the monks from the Carthusian Monastery of Scala Dei, founded in 1194, introduced the art of viticulture in the area. The prior of Scala Dei ruled as a feudal lord over the seven villages in the area; this gave rise to the name Priorat.

Priorat is celebrated for its powerful red wines, which came to international attention in the 1990s. The area is characterized by its unique terroir of hot, dry climate, long growing season, and llicorella soils. Based on the soil taxonomy system of U.S. Department of Agriculture, these soils are classified as *Lithic Xerorthents*. The parent material for llicorella is the dark micaceous Paleozoic slate and schist underlying the rugged terrain.

Vintage Geology *continued on page 65*



Geological Map of Priorat

HGS Welcomes New Members

New Members Effective February 2014

ACTIVE MEMBERS
Page Alexander
Sam Beckham
Carla Diaz
Nathan Gabelman
Marita Gading
Anna Harvey
Thomas Hearon IV
Randi Hedberg
Sonia Hernandez-Cordon
William Hilarides
Wes Johnson
Rhys Jones
Jeff Kane
Stacey Lyne
Matthew Menchaca
Matthew Mendel
Robert Lynn Miller
Bailey Nelson
Yaccine Oukaci
Cort Peavy
Chuck Peng
Stefanie Pipis
Jeffrey Sieler
Yves Simon
Adam Smith
Lauren Stout
B. Taylor Troiani
Michelle Vitale
Sharon Wang
Howard Wood
David Yates
Autumn Eakin
Sarah Regen
Helena Menendez
Colton Key
David Schoderbek

ASSOCIATE MEMBERS
Karla Keeton-Page
Varun Munjal
Scott Sattler

EMERITUS MEMBERS
L. Rogers Hardy

STUDENT MEMBERS
Toyly Abdullayev
Nathainail Bashir
Kivanc Biber
Emilia Caylor
Gerardo Gaitan
Vu Ha
Simpson Pham
Harsh Vora
Liz Zhang
Rui Zhou

New Members Effective March 2014

ACTIVE MEMBERS
Paige Bailey
Ryan Banas
C Scott Cameron
Carlos Davila Vivas
Fabian Duque
Emeka Ejika
Sarah Fitz-Gerald
Sarah Foerster
Taylor Friesenhahn
Jessica Garrison
Denver Gartner
Brian Gille
Tom Gosnell
Wei Guan
Karin Guardia
David Hansen
Edward Jones
Leigh Justet
Robert Klimentidis
Darin Lang
Syed Zulfiqar Hyder Moosavi
John Mosley
Mack Olson
Olusegun Osadiya
George Pemberton
Mark Rudnicki
Rong Shu
Stephanie Storckman
Matthew Wasson
Jon Ehrhart
Uchenna Ikediobi
Rachel Marzen
Patrick Meazell
Ijeamaka Okechukwu
Andrea Price
Gabrielle Ramirez
David Reynolds

STUDENT MEMBERS
Ahmed AlZayer
Derek Bammel
Daniel Burton

Welcome New Members

Vintage Geology continued from page 63

The crumbly llicorella is well drained, yet retains enough water to allow producers to avoid irrigation in this dry region. The vines are forced to send roots deeply into the soil seeking moisture and nutrients. Irrigation is avoided to prevent dilution of the fruit. The harsh growing conditions and the extremely old vines (averaging between 35–60 years old) planted on steep terraces produces very low yields which makes Priorat wines dense, rich, concentrated, and dark colored with distinct tannins. The traditional Priorat wine would be almost black in color and require years of aging before it would be approachable to drink.

The Geological Setting

In 1852, S.P. Pratt described the geological setting of Catalonia in the *Quarterly Journal of the Geological Survey*, as "a series of hills, which take a direction from the north-east to the south-west, nearly parallel to the coast; they are separated from each other by undulating plains or valleys of nearly the same width as the ridges, varying from five to twelve miles. These hills occasionally rise to a considerable elevation, from 2000 to 3000 feet. As great disturbance has taken place near the chain of the Pyrenees, these parallel ridges do not assume their predominant character nearer than about twenty miles from the base of these mountains; but even beyond this distance, they are considerably disturbed here and there throughout their extent by igneous action and the protrusion of masses of granite."

The Priorat region has complex geology and sits between two of the great geomophological units of the north-eastern part of the Iberian Peninsula: the Ebro Basin to the north and the Catalan Mediterranean System to the south. The Montsant range is formed by the Paleogenic sediments of the Ebro Basin boundary, while the mountain chain of Priorat form the subsoil of a high central area, with subunits of Triassic outcroppings in the western and southern parts.

The Priorat mountain chain is the only outcrop of Paleozoic basement along Catalan Coastal Range. The September 2006 field trip guide from the *European Society for Soil Conservation International Conference* on "Soil and Water Conservation under Changing Land Use," by Ildefonso Pla, José Antonio Martínez-Casasnovas, Mª Concepción Ramos, and Josep Carles Balasch, indicates that the Paleozic rocks consist of Carboniferous clastic sediments with rhythmic sequences of sandstones, schists, calcareous materials, and in lower quantity, lidites, breccias, and conglomerates. This group can be considered turbidite deposits of a submarine fan system and may have a thickness in excess of 2000 meters. Carboniferous rocks are found as uncorformable layers on top of the carbonates and clastic Devonian sediments consisting of dark grey shales and quartzites, and in lower proportions, brown, black, and green lidites.

The thickness of the Devonian unit is about 250 meters, corresponding to pelagic and abyssal deposits. The Paleozoic sedimentary rocks are intruded by igneous rocks including biotitic granodiorites, porphyric granites, and tonalites.

The Carboniferous sediments were also affected by regional low-degree metamorphism from the Tardihercynian age (approximately 275 million years ago), representing green schist facies. The Paleozoic rocks are crossed by a NE-SW strike-slip fault system. Early Triassic sediments are located on top of the Paleozoic basement in southern Priorat.

The Paleozoic rocks in Priorat were further folded during the Alpine deformation. These structures basically consist of a set of folds and sinistral strike-slip faults. The frontal zone of the Priorat unit overthrusts the Ebro basin by an inverse fault, forming a blind thrust, which was covered by tertiary sediments in progressive unconformities. The present landscape of the Priorat massif is the consequence of Pliocene and Quaternary incision of the drainage network of many rivers.

Tasting Notes

The 2011 Black Slate pours brightly from the dark bottle filling the glasses with its aromatic nose of toast, smoke, red fruit, rose petal, oak, mushroom, blackberry, cedar, and cigar box. Jeb Dunnuck, of the *Rhone Report*, calls Black Slate 2011 "voluptuous, sweetly fruited, and downright decadent, it boasts awesome aromatics of kirsch liqueur, chocolate, liquid mineral, and baking spices to go with a full-bodied, rounded, supple feel in the mouth."

The tasting panel admired the deep, rich, dark purple color and silky body of this big wine. One panelist remarked on intense flavors of spicy blackberry supported by structure and acidity as well as "spicy cinnamon notes in the finish." Another noted flavors of "chocolate coffee" framed with a dry finish and a roughness towards the end. Priorat wines were traditionally known for rough, rustic, brambly character, but the new class of winemakers are developing more refined, well-balanced wines. This panelist observed tastes of cassis, currant, tobacco, spice, and oak with a dusty mineral underpinning. Is that mineral underpinning a taste of the terroir of llicorella and Paleozoic slate? Could be, pour some more to test. Salud! ■

Remembrances

by Linda Sternbach and David Miller
Should you hear of a fellow HGS member's or contributor's passing, please send information to the Editor-Elect at davidwayne.miller55@gmail.com.

Daniel J. Tearpock

Daniel John Tearpock passed away peacefully in his Houston home surrounded by family, following a three year battle with pancreatic cancer on Sunday, February 9, 2014. A long-time Houston Geological Society (HGS) member, supporter, and volunteer, he leaves behind a substantial personal and professional legacy, and will be missed by his family, many friends and professional colleagues, and students of geology around the world.

Dan graduated from Bloomsburg University in 1970 with a B.A. in earth sciences, and returned to school for his master's degree in geology from Temple University in 1977. By 1985, he was a senior geological engineer with Tenneco Oil Company in Lafayette, La. In 1988, he formed Subsurface Consultants & Associates, LLC (SCA) which quickly grew into an international consulting and training firm with multiple branch offices.

As a working geoscientist, Dan generated numerous exploration and exploitation prospects, either as the sole generator or as part of an organized multidisciplinary team. He co-authored three textbooks: "Applied Subsurface Geological Mapping" (1991), "Quick Look Techniques for Prospect Evaluations" (1994), and "Applied Subsurface Geological Mapping with Structural Methods" (2003). In addition to these books, he authored or co-authored numerous published technical articles. He was a recipient of the Heritage Award from American Association of Petroleum Geologists' (AAPG) Division of Professional Affairs in 2012 and the AAPG Honorary Member Award in 2013. Dan was a finalist in 1996 and 1998 for the Ernst & Young Entrepreneur of the Year program and in 1998 received the Distinguished Service Award from Bloomsburg University, Bloomsburg, PA from which school he received his bachelor's degree in geology.

Dan was a member of numerous professional associations including the AAPG, Society of Petroleum Engineers (SPE), Society of Independent Professional Earth Scientists (SIPES), Society of Exploration Geophysicists (SEG), Geological Society of America (GSA), HGS, European Association of Geoscientists and Engineers (EAGE), New Orleans Geological Society (NOGS), Louisiana Geological Survey (LGS), Indonesian Petroleum Association (IPA), South East Asia Petroleum Exploration Society (SEAPEX), and the Petroleum Exploration Society of Great Britain (PESGB). He was the President of the AAPG's Division of Professional Affairs (2010-2011), and a founding member and Vice-Chairman (2009-2011) of the intersociety "Joint Committee on Reserves Evaluator Training" (JCORET).

SCA President Hal Miller notes, "Dan showed great courage by starting a consulting and training business in 1988 during an oil price slump. It is a tribute to his legacy that he not only kept SCA alive for 25 years, but also established an outstanding global reputation for himself and the company. Dan had the foresight to transition SCA operations to his management team over the past few years, and we all benefited greatly from his exceptional knowledge of oil industry technical training and consulting. He will be remembered for years to come for his many contributions to the education of geoscientists around the world and for the enduring textbooks and courses that he authored. He built a strong foundation on which SCA continues to grow."

Dan and his family requested that in lieu of flowers, donations be made in his name to St. Jude Children's Research Hospital (http://giftshop.stjude.org/stjude/). Please use tribute DANIEL TEARPOCK #35296595 when donating. Donations may be made online, by phone at 800-822-6344, or by mail to St. Jude Holiday Card Program; PO Box 1000, Dept. 142; Memphis, TN 38148-0142.

Government Update

*by **Henry M. Wise, P.G.** and **Arlin Howles, P.G.***

If you'd like the most up-to-date Texas rules, regulations, and governmental meeting information, we direct you to the HGS website to review The Wise Report. *This report, which comes out as needed but not more often than once a week, offers the most up-to-date information that may be of interest to Texas geologists.*

AGI Monthly Review (January 2014)

Oil and Gas Regulators in Texas Turn to Seismology

The Texas Railroad Commission (RRC) announced that it will hire an in-house seismologist following a series of earthquakes in the small town of Azle, Texas. Azle sits atop the Barnett Shale, one of the largest and richest deposits of natural gas in the state, which has undergone extensive hydraulic fracturing. Increased seismic activity has been attributed mainly to the reinjection of wastewater, rather than to hydraulic fracturing itself.

Groups Demand US Export Crude Oil

Senator Lisa Murkowski (R-AK), Ranking Member of the Senate Energy and Natural Resources (ENR) Committee and a major proponent of oil and gas development, is calling for the government to reduce regulations on U.S. exports of crude oil. Aside from limited exports to Canada, industry within the U.S. is currently forbidden from selling crude oil to international buyers.

The ENR Committee held a hearing on January 30, 2014 investigating the possibility of exporting American produced oil and gas. An archived webcast of the hearing can be found at: www.energy.senate.gov/public/index.cfm/hearings-and-business-meetings?ID=4257c751-1911-4467-aaa5-0ff7863777fa.

Governor calls for drillers to follow now defunct water regulations

On December 20, 2013, the Pennsylvania Supreme Court struck down Act 13, state drilling regulations that would have established a protected zone around Pennsylvania's waterways, preventing any drilling within 300-feet of them. This January, however, the Pennsylvania Governor called on drillers to honor the law even though it was struck down.

Although the state Department of Environmental Protection has not received any new applications honoring the Governor's request, those associated with Pennsylvania oil and gas companies report that they will comply with the additional regulations.

The state supreme court ruled Act 13 unconstitutional because it attempted to supersede local zoning rules.

New Developments in Seismic Exploration and OCS Future

On January 10, 2014, the House Committee on Natural Resources, Subcommittee on Energy and Mineral Resources held a hearing to discuss seismic exploration on the Mid- and South Atlantic Outer Continental Shelf (OCS). Companies are interested in exploring for hydrocarbon resources in the Mid- and South Atlantic OCS, and marine seismic surveying is a first step in deep-water resource exploration.

The Bureau of Ocean Energy Management has been conducting a Programmatic Environmental Impact Statement (PEIS) since 2009 to determine the impacts of seismic surveying on marine life in the Atlantic. Oil and gas companies want to expedite publication of the PEIS. The last seismic surveys were conducted in 1988, however new 3D/4D surveying technology can better map the subsurface, allowing for new discovery of potential oil/gas/mineral resources.

Proponents, led by Subcommittee Chairman Doug Lamborn (R-CO), endorsed the approval of seismic surveying and advocated for expedience in producing the PEIS final report. They reasoned that this initial seismic surveying would not harm marine life, and that the potential benefits that could result from drilling, such as jobs and independence from foreign energy sources, far outweigh potential environmental impacts.

Many Democrats were concerned about the impacts of seismic surveying on marine life and the environmental impacts of possible future drilling, mentioning that industry negligence caused the Deepwater Horizon Spill in 2010.

House Bill Amends CERCLA, Expanding States Rights

The Reducing Excessive Deadline Obligations Act (H.R. 2279) passed the House of Representatives 225-188 on January 9, 2014. In an attempt to speed up the process and give states more control, the bill amends the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) to provide fewer deadline regulations and require federal entities to give priority to state and local laws when conducting CERCLA cleanups. Environmental groups, however, are skeptical that the bill provides for due diligence, and the White House has threatened to veto the bill.

CERCLA is the foremost piece of legislation holding corporations responsible for chemical, petroleum, or otherwise hazardous spills. It imposes a tax on the chemical and petroleum industries, collecting those funds for use in case of hazardous spills or to facilitate in the cleanup of abandoned hazardous waste sites.

Government Update *continued on page 68*

Government Update continued from page 67

Update on OSM Stream Protection Rule
The House Natural Resources Committee has launched a new set of hearings devoted to analyzing the potential socioeconomic impacts of the Office of Surface Mining's (OSM) proposed Stream Protection Rule (SPR).

The OSM is working to overcome a controversy in which sensitive documents leaked indicating the proposed SPR would result in greater job losses than previously expected. Many House Republicans are working to pass legislation barring the OSM from passing any more regulations on the coal industry, while most Democrats agree that additional limitations are needed.

Over the past several years, the federal government has endeavored to enact stricter regulations on coal mining in the United States to protect local communities and the environment from runoff and pollution associated with mining activities. The latest regulatory strategy, the Stream Protection Rule, focuses on the effects of surface coal mining on aquatic environments.

EPW Committee Evaluates President Obama's Climate Action Plan
On Thursday, January 16, the Senate Committee on Environment and Public Works (EPW) held a full committee hearing on the implementation and effects of President Obama's Climate Action Plan (CAP). Witnesses included the Administrator of the Environmental Protection Agency (EPA), the Chair of the Council on Environmental Quality, and the Director of the US Fish and Wildlife Service.

Instituted in June 2013, CAP plans to reduce carbon pollution, grow the green economy, prepare for the adverse effects of climate change, and commit U.S. leadership in a global initiative to combat climate change. Proponents of the President's climate policy believe that the plan will help improve environmental health while maintaining a robust, competitive economy. Opponents of the President's plan argued that unnecessary CAP regulations will stymie economic development.

Democratic members mentioned anecdotal accounts of the detrimental effects of climate change in their respective states, such as the economic damage to infrastructure and tourism in New Jersey caused by Hurricane Sandy, while Republicans criticized the EPA, which is charged with implementing a number of CAP regulations, and argued that climate science is not wholly undisputed.

Because cutting carbon pollution is integral to the CAP, debate ensued over the EPA's right to regulate CO_2 under the Clean Air Act. The EPA's new directive focuses on standards associated with power plant emissions, which currently contribute to 33 percent of total carbon emissions in the U.S. Many opponents of CAP also expressed concerns about the Treasury Department's reticence in their development of the carbon tax. Opponents also stated that without international participation, U.S. efforts to curtail emissions will have little effect on global climate.

EPA releases outline of decision to raise the Social Cost of Carbon
On January 16, 2014, Ranking Member of the Senate Environment and Public Works Committee David Vitter (R-LA) received a letter from the EPA explaining the Obama Administration's new definition of the social cost of carbon (SCC). In 2013, the Administration raised the SCC estimate from $24 per ton of CO2 released into the atmosphere (a 2010 estimate) to $33 per ton. Lost agricultural output, increased energy use, impacts to human health, and property damage, among other adverse climate-related effects, factored into the elevated cost.

The EPA letter was in response to a June 2013 letter from Sen. Vitter and other Republican senators who questioned the process for recalculating the SCC. The SCC is used in cost-benefit analyses for CO_2 regulation and there are concerns that the increased estimate could produce added costs for industry and consumers.

The EPA reply stated, "The SCC imposes no cost, but instead, allows the benefits of emissions reductions to be compared to the costs of mitigation policy within cost-benefit analyses." According to the EPA, versions of the SCC have been used in regulation of light duty vehicles, sewage sludge incinerators, and a 2012 utilities air toxics rule.

Suzette Kimball nominated to lead U.S. Geological Survey
President Obama has nominated the current Acting Director of the U.S. Geological Survey (USGS), Suzette Kimball, to assume the position full time. Kimball, a veteran of the Survey, has served numerous functions within the organization since joining in 1998, including the Director for the Eastern Region, Associate Director of geology, and Deputy Director of the USGS.

Navy to Update Arctic Strategy
On January 22, 2014, the U.S. Navy previewed a new strategy for the Arctic polar region at the Center for Strategic and International Studies, updating their 2009 plan. Certain climate models predict the Arctic could be ice free before 2050, necessitating new strategies and opening routes previously inaccessible in the region. Rear Admiral Jonathan White, an oceanographer for the Navy who is overseeing the formation of the strategy, reports that sea ice minimums are about 50 percent lower now than in the 1970s, with more seasonal ice melting each year. Furthermore, the new strategy reports that the Northwest Passage, which connects the Atlantic and Pacific Oceans via the Arctic Ocean, could be "intermittently open" by 2025, and Russia's Northern Sea Route could have annual brief openings, creating a new transpolar route.

The Navy policy, set to be released in several weeks time, will

follow the White House, Defense Department and Coast Guard plans. The White House strategy called for U.S. ratification of U.N. Convention on the Law of the Sea.

Because of the dangers associated with navigating the uncharted seaways, "Improved mapping of the Arctic and better wide-band communications are needed," said White. The Navy is also working to define the type of ships and aircraft needed to navigate the newly created waters.

Human-induced Earthquakes up, USGS reports

The USGS reports that human-induced seismicity may be the cause of increased domestic earthquake activity over the past several years. The federal agency released numbers indicating that the U.S. averaged around 20 earthquakes of magnitude 3.0 or larger per year between 1970 and 2000. That number, however, jumped to more than 100 earthquakes per year between 2010 and 2013, with more than 450 earthquakes greater than magnitude 3.0 during that four-year period.

USGS scientists examined several factors when deducing whether the greater number of earthquakes were a result of natural or man-made causes, including local geologic conditions and the presence of wastewater injection sites. They concluded that the increase in seismicity at some locations coincides with wastewater injection in deep disposal wells.

EPA Releases Assessment on Mining in Bristol Bay

On January 15, 2014, the EPA published a report on the potential environmental impact of a major open pit mining operation in Alaska's Bristol Bay watershed. Currently, Northern Dynasty Minerals Ltd. is attempting to develop a new mining project within the region but has not yet applied for mine permits. Their Pebble Mine might become the largest copper and gold mine ever constructed.

Some Alaskan tribes and residents believe the Pebble Mine could be economically beneficial, while others are concerned about the detrimental impacts to the salmon population, which many rely upon for their livelihoods.

The Bristol Bay watershed is home to the largest sockeye salmon fishery in the world. "Bristol Bay's ecological resources produced $480 million of direct economic expenditures and sales in 2009," and supported more than 14,000 full- and part-time workers, according to the EPA. Report findings conclude that a mine could contaminate between 24 and 94 salmon streams and 1,300 to 5,350 acres of wetlands, ponds, and lakes. A mine would produce large amounts of mine waste, leachates, and waste water that would require long-term management.

The EPA reports that they considered input from independent scientists and reviewed public comments from more than 1 million people in their assessment. The preliminary report has no regulatory effects, but will be used by as a technical resource by decision makers.

Critics of the EPA report include Pebble LP CEO John Shively, who said $600 million dollars have been invested in environmental/engineering studies to plan a responsible mine. Since Pebble has not yet submitted a project request, Shively considered the hypothetical report outdated and completely inaccurate. A summary of the report is available at www.eenews.net/assets/2014/01/15/document_pm_01.pdf.

AIPG eNews (January 14, 2014)

Mega-landslide in Giant Utah Copper Mine May Have Triggered Earthquakes

The largest non-volcanic landslide in the recorded history of North America took place April 10, 2013, during two episodes of collapse at Kennecott's Bingham Canyon open-pit copper mine in Utah. In the January 2014 issue of *GSA Today*, University of Utah geologists report the initial findings of their study of the seismic and sound waves generated by this massive mega-landslide. They found that each of the two landslide events produced seismic waves equivalent to a magnitude 2 to 3 earthquake. For more information go to: www.sciencecodex.com/megalandslide_in_giant_utah_copper_mine_may_have_triggered_earthquakes-125733

AIPG eNews (February 4, 2014)

A Newly-detected Fracture Suggests that Tectonic Forces are Pulling the Continents Together Once Again.

Geologists mapping seismic activity and underwater topography off the coast of Portugal say the tectonic forces that once split and spread the ancient supercontinent Pangea across the surface of the globe appear to be shifting into reverse, setting our existing continents on an eventual collision course.

While constructing a new tectonic map of the area, Monash University geologist João Duarte observed an inkling of a fracture in the normally intact and inactive plate that underlies the Atlantic Ocean. Such a fracture, says Duarte, is evidence of an "embryonic subduction zone," where a new edge is formed, then forced under the remainder of the plate, into the Earth's molten mantle. This process pulls the continents on the surface closer together.

His findings, published in *Geology* (http://geology.gsapubs.org/content/early/2013/06/05/G34100.1.abstract) in June, provide a possible explanation for the creation of midplate subduction zones that have long eluded plate tectonic theorists, and suggest that oceanic closing may already be underway in the Atlantic.

The slow process of continental spreading and reassembly has occurred only three times in Earth's history, and we've got another 220 million years to go before Europe and the Americas reunite, so don't start planning your trans-Atlantic road trip just yet. ■

Full Color Ads Now Available!

HGS *Bulletin* Instructions to Authors

All materials are due by the 15th of the month, 6 weeks before issue publication. Abstracts should be 500 words or less; extended abstracts up to 1000 words; articles can be any length but brevity is preferred as we have a physical page limit within our current publishing contract. All submissions are subject to editorial review and revision.

Text should be submitted by email as an attached text or Word file or on a clearly labeled CD in Word format with a hardcopy printout to the Editor.

Figures, maps, diagrams, etc., should be digital files using Adobe Illustrator, Canvas or CorelDraw. Files should be saved and submitted in .ai (Adobe Illustrator) format. Send them as separate attachments via email or CD if they are larger than 1 MEG each, accompanied by figure captions that include the file name of the desired image. DO NOT EMBED them into your text document; they must be sent as separate files from the text. DO NOT USE POWERPOINT, CLIP ART or Internet images (72-DPI resolution) as these do not have adequate resolution for the printed page and cannot be accepted. All digital files must have 300-DPI resolution or greater at the approximate size the figure will be printed.

Photographs may be digital or hard copy. Hard copies must be printed on glossy paper with the author's name, photo or figure number and caption on the back. Digital files must be submitted in .tif, .jpg or .eps format with 300-DPI or greater resolution at the printing size and be accompanied by figure captions that are linked by the file name of the image. The images should be submitted as individual email attachments (if less than 1 MB) or on CD or DVD.

Advertising

The *Bulletin* is printed digitally using InDesign. Call the HGS office for availability of ad space and for digital guidelines and necessary forms or email jill@hgs.org. Advertising is accepted on a space-available basis. **Deadline for submitting material is 6 weeks prior to the first of the month in which the ad appears.**

Random Inside (Black & White)					Page 2 (B&W)	Inside Front Cover (Full Color)	Inside Back Cover (Full Color)	Outside Back Cover (Full Color)	Calendar Back (Full Color)	Calendar Page (Full Color)
No. of Issues	Random* Eighth	Random* Quarter	Random* Half	Random* Full	Full	Full	Full	Half	Full	Quarter
10	$823	$1,387	$2,488	$4,734	$5,680	$7,830	$7,560	$6,858	$6,750	$2,700
9	$823	$1,387	$2,488	$4,734	$5,680					
8	$750	$1,260	$2,242	$4,307	$5,169					
7	$665	$1,123	$2,014	$3,834	$4,600					
6	$590	$990	$1,782	$3,392	$4,069					$1,890
5	$497	$837	$1,503	$2,860	$3,432	$4,698	$4,536	$4,104		
4	$405	$683	$1,223	$2,326	$2,792					
3	$327	$550	$990	$1,886	$2,262					$1,080
2	$232	$392	$704	$1,339	$1,607					
1	$146	$246	$443	$842	$1,010	$1,404	$1,296	$1,080		$810

FULL COLOR AD
* add 30% to B&W charge for full (4) color ad

BUSINESS CARD
$160 per 10 Issues – Send two cards
($30 for each additional name on same card)

Website Advertising Opportunities

HGS has multiple website advertising opportunities for your company! We've expanded our offerings to include a 275 x 800 pixel, rotating banner ad on the front page of the website. We have kept the popular Event Calendar and Geo-Job Postings advertisement locations!

	Home page Banner	Home Page (200 x 400 pixels)	Event Calendar (200 x 400 pixels)	Geo-Jobs (120 x 90 pixels)	Website Business Card (Members Only)	Personal Resumes (Members Only)
One year	$3,000.00	$2,800.00	$2,500.00	$1,400.00	Free	Free
6 months	$2,000.00	$1,800.00	$1,500.00	$750.00	Free	Free
3 months	$1,500.00	$1,300.00	$1,000.00	$450.00	Free	Free
Monthly	$ 700.00	$500.00	$ 400.00	$200.00	Free	Free

We still offer Geo-Jobs - where your company can post job openings for 14 days at $50.00 or 30 days at $100.00.

For more information regarding website advertising visit HGS.org or email jill@hgs.org.

Application to Become a Member of the Houston Geological Society

Qualifications for Active Membership

1) Have a degree in geology or an allied geoscience from an accredited college or university; or
2) Have a degree in science or engineering from an accredited college or university and have been engaged in the professional study or practice of earth science for at least five (5) years.

Qualifications for Associate Membership (including students)

1) Be involved in the application of the earth or allied sciences.
2) Be a full-time student enrolled in geology or in the related sciences.

Apply online at www.hgs.org and click on Join HGS

Annual Dues Expire Each June 30. (Late renewals – $5 re-instatement fee)
Annual dues are $24.00; emeritus members pay $12.00; students are free.

Mail this application and payment to:
Houston Geological Society
14811 St. Mary's Lane, Suite 250 • Houston, TX 77079-2916
Telephone: 713-463-9476 Fax: 281-679-5504

Payment method:

☐ Check, ☐ VISA, ☐ MasterCard, ☐ American Express, ☐ Discover

Card # _____

Expiration Date: _____ Card I.D. _____

(Card I.D. – 3 or 4 digit number on front or back of card)

To the Executive Board: I hereby apply for ❑ Active or ❑ Associate membership in the Houston Geological Society and pledge to abide by its Constitution and Bylaws. ❑ Check here if a full-time student.

Name: _____
Address: _____
_____
Home Phone: _____ *Spouse's Name:* _____
Email: _____
Job Title: _____
Company: _____
Company Address: _____
_____
Work Phone: _____ *Fax Number:* _____
Circle Preferred Mailing Address: Home Office
Professional Affiliations: _____
❑ AAPG member No.: _____
Professional Interest:
❑ Environmental Geology ❑ North American E&P (other than Gulf Coast)
❑ International E&P ❑ Gulf Coast E&P (onshore & offshore)

School _____
Degree _____ *Major* _____ *Year* _____
_____
School _____
Degree _____ *Major* _____ *Year* _____

Earth Science Work Experience _____
_____
_____
_____

Applicant's Signature _____ *Date* _____

Endorsement by HGS member (not required if active AAPG member)

Name: _____

Signature _____ *Date* _____

Membership Chairman _____ *HGS Secretary* _____

revised 8/6/10

Houston Petroleum Auxiliary Council News

Edie Bishop, *HGS Liaison* 713-467-8706 or ewbishop@bishorb.com

After an unusually long and cold winter, Houstonians are enjoying our beautiful spring. What a great time to be outdoors soaking in the sun, wildflowers and a little Texas history. With this in mind, **Martha Lou Broussard** and **Linnie Edwards** have planned an exceptional HPAC Exploring Houston spring trip.

April 21st is San Jacinto Day and Martha Lou has planned a field trip for that day but not to San Jacinto as that trip has already been done. This spring the trip will be to Galveston to learn about a city that was first settled by Europeans in about 1816. It was once a major port for the Texas Gulf Coast and is still a lively port with both commercial and cruise activity and the Marine Science School which is a branch of Texas A&M University. The city is a cat with nine lives. It was almost completely destroyed by the 1900 hurricane with a loss of between 6000 to 8000 lives and has been hit by several more hurricanes including recently by Hurricane Ike in 2008.

There are so many things to see in Galveston that one could easily spend a week just being a tourist but not this time. The morning will begin with a tour of the Ocean Star, an offshore platform that is now a museum. Since most folks never get to see an offshore platform, this is a special opportunity for oil folks. After lunch there will be a showing of the film, *The Great Storm*, which features photos of Galveston during the 19th century before the storm and the aftermath of the great devastation of this hurricane. Next is a tour of the historic East End with a guide from the Galveston Historical Foundation. Galveston has over 60 structures on the National Register of Historic Places and the majority of them are in this district. Also key viewings are the wooden sculptures cut out of the trees that drowned in the Hurricane Ike tidal surge. Of course, it would not be an HPAC trip if there was not a time to wander the Strand and peek into some of the shops that give Galveston so much character before returning to Houston.

L to R: Margery Ambrose, Vicky Pickering, and Gale Ideus at the Winter Luncheon

L to R: Mike McQuinn, Sheri McQuinn, Martha Lou Broussard, Sandra Pezetta, Jane Long, Vicky Pickering, Linnie Edwards, Anita Weiner, and Mickey Murrell during a recent science trip.

Reserve your spot on the bus by sending a check for $35 (lunch, entrance fees and tour guide) made to HPAC and mailed to **Martha Lou Broussard**, 3361 Bellefontaine, Houston, Texas 77025 by April 14. Guests are welcome. If you are interested in making this trip, meet at Memorial Drive Presbyterian Church at 8:30, leaving at 8:45 and returning about 5:30.

Special thanks are extended to the members of HPAC for helping in the hospitality room at this AAPG Annual Convention. Also, great appreciation to **Penny Nelson**, wife of **Ron Nelson**, and **Harriett Brittenham**, wife of **Marv Brittenham**, for sharing their knowledge and expertise in their presentations thus making the Enrichment Programs an outstanding venue.

HPAC Book Club, under the leadership of **Phyllis Carter** and **Anita Weiner**, continues to offer insight and depth into the books being reviewed. The last meeting was no exception. Discussion leader **Cathy Gerszenkorn** brought the book *Trapeze* up close and personal by sharing her father's experiences with one of the maquis cells of the French Resistance and her research into the women of the Special Operations Executive of the British World War II. What an opportunity! Watch the May *Bulletin* for details of the next upcoming meeting.

An appreciation is extended to all our special interest groups leaders: *Bridge:* **Audrey Tompkins**, 713-868-0005 or **Daisy Wood,** 832-581-3231, *Book Club*: **Phyllis Carter**, 281-397-9888 or A**nita Weiner**, 713-572-9874, and *HPAC Exploring Houston*: **Martha Lou Broussard**, 713-665-4428 or **Linnie Edwards**, 713-785-7115. Spouses and guests are also always welcome and encouraged to attend all events.

Geologists, please encourage your spouses to join HPAC, where they will have an opportunity to meet other spouses of geologists, geophysicists, engineers, and landmen. They will participate in informative and entertaining programs, delicious lunches and welcoming fellowship. The HPAC membership form is included in the HGS *Bulletin*. Contact **Edie Bishop** at 713-467-8707 or ewbishop@bishorb.com for more information. ■

You are invited to become a member of

HPAC

2013–2014 dues are $20.00 Mail dues payment along with the completed information

to **Nancy Giffhorn** • 16107 Hidden Lakes Drive • Kingwood, Texas 77345

YEARBOOK INFORMATION

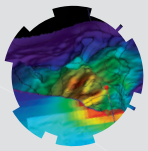
Last Name	First Name	Name Tag
Spouse Name	Company	
Street Address	City State	Zip
Email Address	Home Fax	
Home Phone	Cell Phone (Optional)	Home Email Address

Please choose a committee assignment if you are interested.

☐ Fall Event ☐ Yearbook ☐ Bridge ☐ Membership

☐ Christmas Event ☐ Spring Event ☐ Notification ☐ Book Club

☐ Exploring Houston ☐ Courtesy



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