HGS Bulletin
Houston Geological Society
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The Subsalt Tahiti Field Discovery, Green Canyon 640: Opening Another Deepwater Frontier

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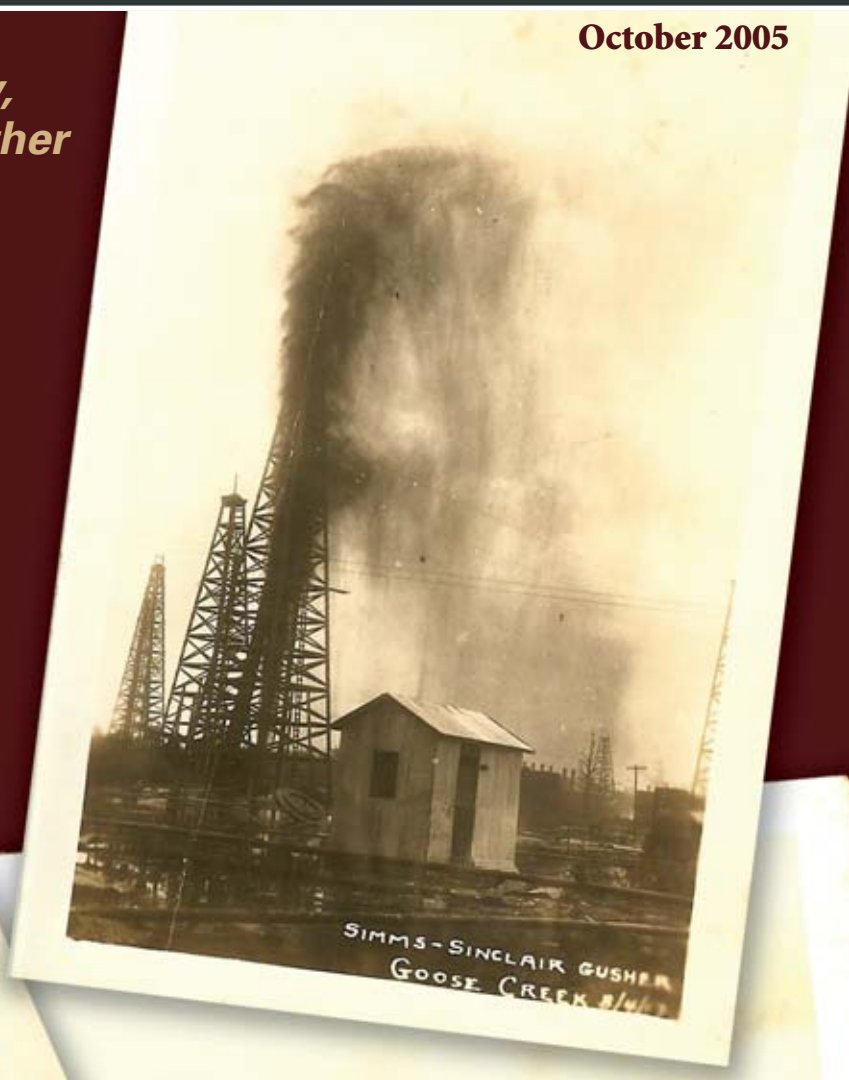

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The Debate Over Subsidence in Louisiana and Texas

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The Bulletin
Houston Geological Society

Volume 48, Number 2 October 2005

In Every Issue

about the cover: The cover photos are from Goose Creek Field in southeastern Harris County on Galveston Bay, taken in 1917. The field was first discovered in 1908. This field is also discussed in the article "The Debate over Subsidence in Coastal Louisiana and Texas" on page 47. ***The photos were originally provided to the Editor by Gene Austin.***

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President's Letter

by ***Dave Rensink***

Why Doesn't It Feel Like an Oil Boom?

Oil prices have gone past $60 per barrel and natural gas prices have surpassed $8 per thousand cubic feet recently. It looks like an oil boom. It smells like an oil boom. So why doesn't it feel like we are in an oil boom? As recently as March and April of this year, such august prognosticators as Goldman Sachs, CIBC world market economists and the International Monetary Fund were predicting the possibility of price spikes up to $100 per barrel during 2005 and 2006. This is attributed to increasing demands in the developing world and the decreasing margin between world production capacity and world demand. Does any of this have a familiar ring to it? Based on the price forecasts we used for economic analyses during the late 1970s, we should have seen $100 oil by the turn of the century. We clearly confused a best-case scenario with reality.

Whose perceptions are driving this oil boom?

Could it be that the excesses of the late '70s and early '80s, which were followed by the dramatic oil price drop in the mid '80s made skeptics and cynics of those of us who lived through it? The current attitude in the oil industry seems to parallel that of my parents, grandparents and others who lived during the Great Depression in the early '30s — things are never as good as they seem, but they can always get a lot worse. In February 1999, the U.S. weighted spot price for oil was approximately $9 per barrel and subsequently rose to $31.50 per barrel in September 2000 before dropping to the next (and last) low of $14.87 per barrel in November 2001. The price has risen fairly steadily during the last four years. Actually, it has had a fairly dramatic rise in the past 18 months. Economists would say that these fluctuations are market corrections around an average price of approximately $23.50 per barrel, which is the average weighted spot price since 1989. Coincidently or not so coincidently, OPEC's business model was based on the assumption that $25 oil is sufficiently high to meet their cash requirements and low enough to maintain market share. OPEC's perceptions have been the world's reality since 1973. However, as the world's demand has increased and OPEC's excess production capacity has declined, OPEC's influence on the world's oil market has also declined. Ideally, a free market responds to real or perceived shortages and surpluses, but whose perceptions are influencing the market today?

Since 1989, world demand has risen from 66 million barrels per day to 80 million barrels per day. During this period, U.S. demand has risen from approximately 20 million to 24.5 million barrels per day. The two growth rates are comparable at approximately 21% to 22%, respectively, over a 15-year period. Thus, the contention that rising oil prices are the result of a robust world economy seems reasonable. A booming world economy should be a good thing. Logic would say that the oil boom, however temporary it may ultimately prove to be, is real, but we do not seem to believe it. Is it that difficult for us to forget the price decline and the contraction of the oil business in the mid 80's, or has there been a fundamental shift in the business?

As an industry, we do not seem to be staffing up as we did during the last boom. There are jobs available, but job-hopping is not as prevalent as it was in the past. Has the technology development during the last 25 years been so significant that we are able to do more with fewer people? No one will argue that there has been a dramatic increase in the use of computers since the last boom. Interpreting 2D seismic data on a drafting table using paper sections and colored pencils now seems like something out of the dark ages, or certainly a museum. Workstations and 3D seismic data have revolutionized the business. They have greatly reduced the interpretation time and increased the reliability dramatically. Unfortunately, I think they have made the interpretation process a little too mechanical, and we have lost a connection with the data. Even efficiency may have a downside, but that is a topic for another soap box at another time. The other aspect of the job market is that there are fewer oil and gas independents than during the last boom; therefore, there are fewer places to go and less competition for the available talent.

It also seems that industry management, in general, has become more risk adverse. This is probably the natural consequence of fewer independents, and the movement of many of the remaining companies into deep water, where projects are much more costly and lead times are longer than projects onshore or on the continental shelf. As a result the decisions made on these projects are less likely to be influenced by what are perceived to be short term fluctuations in product prices. In addition, the industry's top management is no longer

President's Letter *continued on page 9*

CAST 2005 is Coming to Houston and We Need You!

CAST is the Conference for the Advancement of Science Teaching, the annual meeting of the Science Teachers Association of Texas (STAT). STAT is a statewide organization of elementary through college level science teachers dedicated to maintaining the highest levels of science education in Texas schools. One of its goals is to cooperate with other science-oriented organizations in the promotion of good science teaching. CAST will be held in Houston this year on October 27–29 at Reliant Center—This is a great opportunity for HGS to reach out to science teachers across the state! CAST attendance is expected to be over 5000, with science and math teachers coming from Texas and adjoining states. CAST was last held in Houston in 2003, and the HGS had a very strong geology representation there, giving workshops, short courses and field trips and staffing a booth in the exhibit hall. We are planning a strong presence again this year and we are looking for volunteers!

If you have a geoscience presentation and ideas for activities that teachers can take back to their classrooms, we want you! Or if you would like to help out with planned events, we need volunteers to staff the HGS booth and to help with two workshops. One is "From Rocks to Soil and What Happens Along the Way" and the second workshop is "Black Gold, Texas Tea: How to Drill an Oil Well." Additional workshops include "Plate Tectonics" by Dr. Dale Sawyer, "Living on the Texas Coast" by Dr. Bill Dupré and "Fun with Geologic Principles" by Aram Derewetzky. We also have six field trips planned and can use volunteers to help with those as well:

- Bureau of Economic Geology Core Lab–Thursday, October 27, 7:30–12:00
- Chevron Drilling Fluids–Thursday, October 27, 8:30–12:00
- ExxonMobil Research Center–Friday, October 28, 8:30–12:30
- Kerr-McGee Visualization–Friday, October 28, 9:00–1:30
- Galveston Island–Saturday, October 29, 8:00–4:00
- Blue Lagoon–Saturday, October 29, 8:30–4:30

If you are interested in participating in CAST 2005, please contact Alison Henning (alison@henning.com) or Janet Combes (jmcombes@msn.com). Help us get Texas teachers and their students excited about geoscience! ■

Editor's Letter

by ***Paul Britt***
editor@hgs.org

The Sword of Damocles

Top Ten Reasons You Might Be A Geologist: *
9. You have ever found yourself trying to explain to airport security that a rock hammer isn't really a weapon
next month, reason no. 8…

Damocles – (dăm´əklēz), *in classical mythology, courtier at the court of Dionysius I. He so persistently praised the power and happiness of Dionysius that the tyrant, in order to show the precariousness of rank and power, gave a banquet and had a sword suspended above the head of Damocles by a single hair. Hence the expression "the sword of Damocles" to mean an ever-present peril.* (from The Columbia Encyclopedia, Sixth Edition.)

On Monday, August 29, 2005, Hurricane Katrina made landfall on the coast of Louisiana, Mississippi and Alabama, 15 miles east of New Orleans, creating unprecedented damage, losses and human suffering for the United States and probably changing the way we look at natural events forever. This event was inevitable, even predictable, yet largely unprepared for. New Orleans succumbed to two breaks in the protecting levees, causing catastrophic flooding and damage to man-made structures that was beyond the experience of anyone in this country. Water, not wind, was the destructive force. Whole towns in Mississippi were washed away with the storm surge. Offshore production platforms, at the time of this writing, were still being evaluated, but preliminary estimates were that 20% of the production platforms and drilling rigs in the storm's path were damaged beyond immediate repair, or even washed away by the storm. Onshore oil and gas fields were shut-in due to high water and loss of electrical power. Offshore service ports and pipeline centers were damaged or closed for the same reasons. An estimated 25% of the U.S. oil production was lost in a single day, and the price of oil and natural gas shot up.

The need for scientific study of the interaction of natural forces and man-made structures is necessary.

The threat to New Orleans has been known for a long time. The Mississippi River was leveed to protect the shipping port of New Orleans in the late 1800s. As the river increasingly tried to divert to the Atchafalaya River, levees were strengthened and made higher. The bird's-foot delta at the mouth of the Mississippi is a recent feature, the result of the levees, and the sediments that go out into the deep Mississippi Canyon would have otherwise been distributed along the Louisiana coastline and delta, except for man's efforts at the control of nature.

The impact to the man-made structures and facilities is by now obvious. The impact on the shoreline, the marshes and underwater bathymetry is yet to be determined.

The impact that Katrina will have on Louisiana and on the nation's economy is unknown at this time, but will surely be a long-lasting impact. The need for scientific study of the interaction of natural forces and man-made structures is necessary. The geological scientific community can offer a lot of insight into urban planning, but the opinions are split, even within our ranks. At best, we can strive for an objective and rational view of the subject. Conferences, like "Coastal Subsidence, Sea Level and the Future of the Gulf Coast" (page 24) scheduled for next month, may help to encourage the logical exchange of scientific ideas, and lead to decisions driven more by logic and fact, and less by politics, emotion and short-term profit. We can usually see the ever-present perils. It is up to us as scientists to try to lead people away from the Sword of Damocles.

A few years ago, a friend gave me a copy of John McPhee's book *The Control of Nature*. The first chapter in that book is titled "Atchafalaya", which discusses the history of the Mississippi levees and the 1973 flood at the Old River Control Station, a dam separating the Mississippi from the Atchafalaya River Basin. McPhee, a well-known writer of geological topics, though not himself a geologist, details the power of the flood waters in a flood that nearly diverted the Mississippi River. The dam was nearly undercut by the river, and the result would have been a flood into the Atchafalaya Basin with catastrophic results, and a permanent diversion of the Mississippi at Old River. It didn't happen that day, but it illustrates the ever-present peril of trying to overcome nature. The story also talks about portions of New Orleans being below sea-level, and the ever present threat of flooding. It is a story that I would encourage everyone to read.

* * *

I have collected over the years old geology books as a hobby. One of the books is Volume VI of the **Editor's Letter** *continued on page 9*

President's Letter

continued from page 5

compensated for long-term reserve growth; they are compensated for increasing stock price and meeting Wall Street's expectations on a quarterly basis. As a stock holder, I am not totally against this concept, but I think it has changed the decision-making process and the manner in which the oil business responds to the changes in the oil market.

The general public still believes that the oil industry controls the oil price; when in fact, all we do is attempt to respond to it. That sentiment may have been partially correct until 1973, when OPEC took control of the oil market price. As OPEC's excess capacity has declined, so has its grip on the oil price. This brings me back to the earlier question of "Whose perceptions are driving this oil boom?".

On a much more somber note, Katrina has devastated New Orleans, and the best wishes of the HGS go out to those affected — particularly the members of our sister society, the New Orleans Geological Society. All have suffered terribly, but some of those in the most precarious position are the independents whose life's work may have been destroyed by the flood waters. At the very least their maps, logs and other data will be inaccessible for months.

Those of you in Houston who have extra office space and access to a log library may wish to consider providing space and the opportunity for our displaced brethren to reconstruct their prospects. If your log library does not provide "guest privileges," please petition the governing board to establish them. The HGS community outreach committee has been active directing HGS members to various agencies and activities where help is needed, and we greatly appreciate the efforts of everyone involved. A single act of kindness costs little and gains much. ■

Editor's Letter

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U.S.G.S. Twenty First Annual Report, 1899–1900. It's a little amazing, at least to me, to hold and read a book that is 105 years old. The volume covers mineral resources; metallic products, coal and coke. It consists of articles, facts, tables and figures of the estimated resources of the United States in 1899. A great deal of attention was devoted to the coal resources in the United States at that time. I wish I had the first three volumes, to see how oil resources were also discussed.

Then I look at it's year 2000 equivalent, the *U.S.G.S World Petroleum Assessment 2000—Description and Results, Version 1.1*, a four-CD set encased in a single flip-fold CD jewel-case. Also an impressive publication, but it makes me wonder what the year 2100 report will look like, what format it will be in and just what resources will be the focus of its attention. One thing is sure—in the year 2100, someone will still be able to read the 1899–1900 book, but will the 2000 version on 4 CDs still be readable?

Another book in my collection is the AAPG 1941 publication *Possible Future Oil Provinces of the United States and Canada.* It spends a great deal of time outlining the potential of various provinces from Newfoundland to Florida to Alaska, some of which have since developed, and some of which have not. One glaring omission from this publication is the Gulf Coast, and any offshore provinces including the Gulf of Mexico. The offshore areas weren't considered prospective until a few years later, as technology caught up to the visionaries in our field. The HGS logo on the cover of this *Bulletin* was designed in a contest in 1949, and the Gulf of Mexico is prominent in the center of the logo, as eyes were turned toward offshore potential.

* * *

The *Bulletin* has undergone many facelifts and format improvements over the years. But throughout that time, it has always been available to the members and committees as a venue for news. This year, I would like to have some regular columns by committees regarding news of their activities, technical columns of general interest including oil and gas articles, environmental articles and topics that would be of interest to the membership at large. You, the membership, are encouraged to submit articles for publication, and all submissions will be carefully considered. ■

As I was preparing my column for this issue, Hurricane Katrina was making the news. This storm has affected everyone in the HGS in one way or another. HGS members, family and friends have been displaced by it. By the time this column is in print, many of the details that are still sketchy will have been resolved. If anyone has member news, articles of interest or letters regarding Katrina, I would like to encourage them to send it in to the Bulletin *for publication.*

* ***The Top Ten Reasons You Might Be A Geologist*** *will be presented, one at a time, each month for all ten issues this year. Please see the Editor's Letter each month, and feel free to send in your favorite "Reason You Might Be A Geologist" for possible publication in the list.*

Monday, October 10, 2005

Westchase Hilton • 9999 Westheimer
Social 5:30 p.m., Dinner 6:30 p.m.

Cost: $25 Preregistered members; $30 non-members & walk-ups

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 (include your name, e-mail address, meeting you are attending, phone number and membership ID#).

HGS General
Dinner Meeting

by ***Freddy Yip*** *(speaker),* ***Jim Pear and Paul Siegele***
Deepwater Exploration/Projects Business Unit
Chevron North America Exploration and Production Company
Houston, Texas

The Subsalt Tahiti Field Discovery, Green Canyon 640: Opening Another Deepwater Frontier

The Tahiti Discovery, announced in April 2002, represents not only a major oil discovery in the deepwater Gulf of Mexico, but also opens an exciting new deepwater exploration frontier in ultra-deep, subsalt reservoirs. The Lower Miocene reservoirs in Tahiti Field are expected be the deepest producing reservoirs in the Gulf of Mexico when first oil arrives through the pipeline in 2008.

The prospect was located more than 35 miles from the nearest stratigraphic penetration of this interval

The Tahiti Green Canyon 640 #1 well, located in 4,100 feet of water, targeted the hydrocarbon-bearing Lower Miocene section in the emerging Mississippi Fan Fold belt trend, located in south-central Green Canyon (Figure 1). The prospect was located more than 35 miles from the nearest stratigraphic penetration of this interval, and the trend proved to be at a significantly lesser depth than was predicted. The closure tested by the discovery well is a three-way structural nose, trapped against a salt feeder/weld system, buried beneath an 11,000-foot-thick salt canopy. This trap type was considered to be much higher risk than the salt-cored, four-way anticlines previously targeted in the fold belt trend and is very difficult to image on conventional seismic data. Significant stratigraphic risks were also recognized, as pre-drill data were limited.

HGS General Dinner Meeting *continued on page 13*

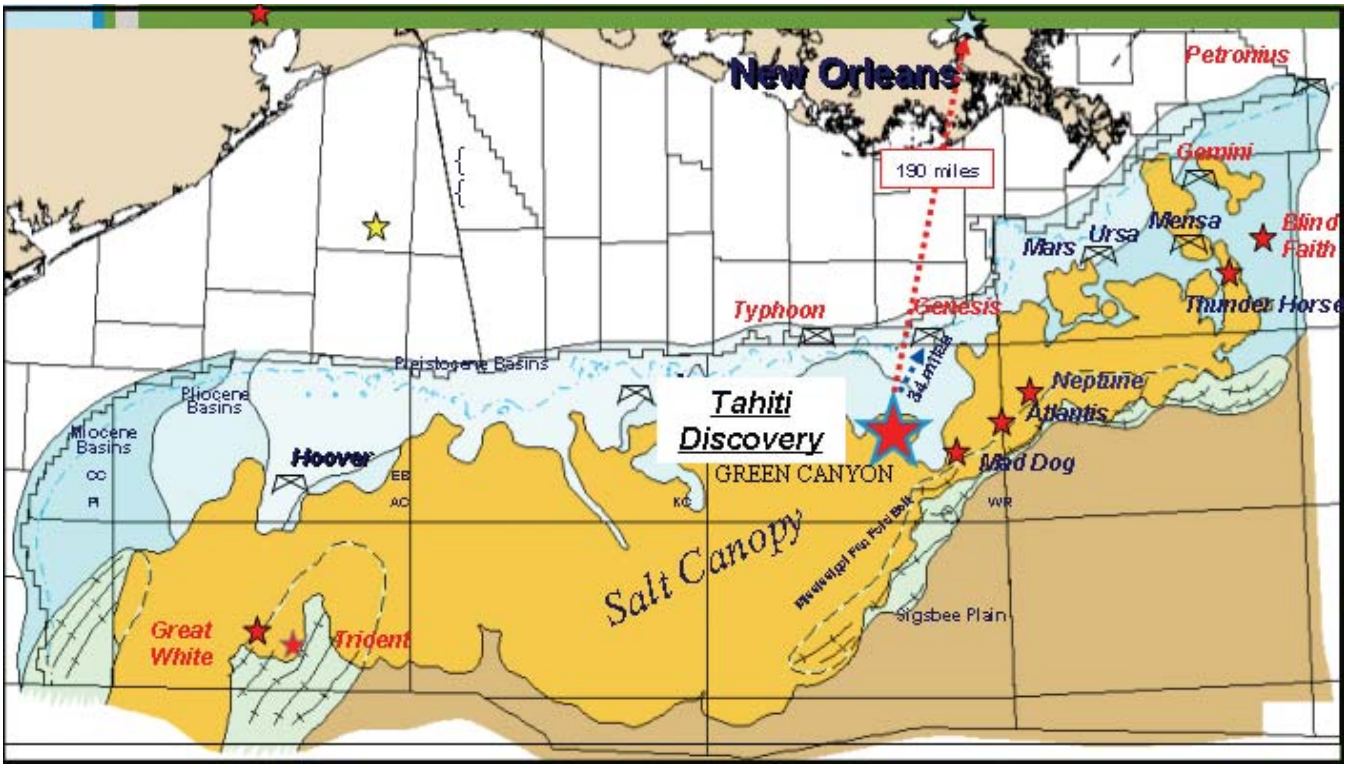

Figure 1. Location map of the Tahiti field, GC 640.

HGS General Dinner Meeting continued from page 11

Photo by Chevron North American E&P.

Figure 2. The rig Cajun Express conducts the Tahiti GC 640 well test in August 2004.

The Tahiti discovery well, spudded in December 2001, successfully confirmed the structural and stratigraphic concepts, encountering more than 400 feet of net oil pay, primarily in three main Miocene turbidite sheet sands at depths ranging from 24,000 to 27,000 feet. Reservoirs penetrated by the well have unusually high quality sands for this depth. Subsequent sidetracking of the discovery and appraisal drilling have confirmed significant hydrocarbon columns of high-quality crude, with excellent reservoir parameters and lateral connectivity (Figure 2). Additional appraisal wells and well tests have resulted in announced recoverable resources of 400 to 500 MMBOE for Tahiti Field.

Future exploratory success for subsalt, ultra-deep reservoirs will need to mirror the successful integration of 3D prestack-depth migration imaging, regional analysis, basin modeling, and prospect scale mapping applied at Tahiti Field. Application of "lessons learned" will be critical, as additional data becomes available in this exciting, but challenging new deepwater frontier. ■

Biographical Sketches:

Freddy Yip (speaker) has been a geologist at Chevron for 24 years, and was involved in new field discoveries in South Texas, the Permian Basin and North Texas. Mr. Yip was the exploration geologist in Chevron's Deepwater Gulf of Mexico Business Unit in New Orleans assigned to mature Tahiti as a prospect in 2001, which resulted in drilling the discovery well in April 2002. After the discovery, he moved into the appraisal phase of Tahiti Field, and to his current assignment as geologist in Tahiti Project Development team. He holds MS and BS degrees in geology from Mississippi State University and the University of Florida.

Jim Pear is east exploration manager in the Deepwater Exploration/Projects Business Unit, within Chevron North America Exploration and Production Company, Houston. Mr. Pear was the exploration team leader during the discovery phase of Tahiti Field. He received a BS in geology from the State University of New York, and an MS degree in geology from the University of Kentucky. He has 26 years of work experience with Chevron in New Orleans and Houston.

Paul Siegele is vice president of the Exploration/Projects Business Unit of Chevron North America Exploration and Production Company in Houston. Mr. Siegele has a BS degree in geology from California Lutheran University and an MS degree from California State University at Northridge.

Monday, October 17, 2005

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

Cost: $25 Preregistered members; $30 non-members & walk-ups

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. (include your name, e-mail address, meeting you are attending, phone number and membership ID#).

International Explorationists Dinner Meeting

by ***Robert Hickman***
Structural Solution

Basins of Offshore Peru: New Exploration Framework and Plays

The prospectivity of Peru's offshore basins has been evaluated by a USTDA funded study conducted by Gaffney Cline & Associates for Perupetro. In contrast to most convergent margins, the coastal basins of the northern continental margin of Peru have been highly productive, producing more than 1.8 billion barrels of oil. This productivity is fundamentally related to the anomalous nature of the continental shelf and upper slope, which are underlain by Precambrian and Paleozoic continental crystalline rocks rather than accreted oceanic rocks. Paleozoic and Cretaceous sediments overlie the crystalline rocks. During the Cenozoic, several extensional basins formed and subsequently were inverted as a result of reactivation of basement faults.

In contrast to most convergent margins, the coastal basins of the northern continental margin of Peru have been highly productive

Unlike offshore basins farther south, the northernmost Tumbes-Progreso basin is a large pull-apart basin. The basin has produced oil and gas from the Neogene section; however, a thicker Eocene section remains essentially untested. BPZ Energy is currently proceeding with the development of Corvna and Pietra Redonda gas fields. Good source rocks are present within the basin. Exploration risks are presented by the complex structure produced by extensional faulting and local inversion, and also by reservoir uncertainties.

The bulk of coastal production has been from the Talara Basin, where numerous Paleogene, Cretaceous and Paleozoic reservoir intervals have been established. Exploration risks relate to reservoir quality and reservoir segmentation caused by multiple sets of extensional faults. Recently, Petro-Tech Peruana made a discovery at the south end of the basin in fractured Paleozoics.

Farther south, the Trujillo Basin has been tested by only four exploratory wells, while the offshore portions of the Sechura, Salaverry and Pisco Basins remain undrilled. Oil seeps and maturation modeling suggest the presence of mature Cretaceous source rocks in all three basins and early mature Eocene source rocks in the Trujillo basin. Anticlinal and fault traps are widespread in these basins as a result of multiple periods of Cenozoic extension and compression. Analysis indicates that two of the four Trujillo wildcat wells were drilled off-structure with respect to deep targets, while the other two tested the basement arch between the Trujillo and Salaverry basins. Reconstructions indicate traps along this arch formed only in the late Miocene. Although this timing diminishes the prospectivity of the arch, it allows charging of traps in the Salaverry basin with hydrocarbons migrating from the Trujillo basin during the late Eocene to early Miocene.

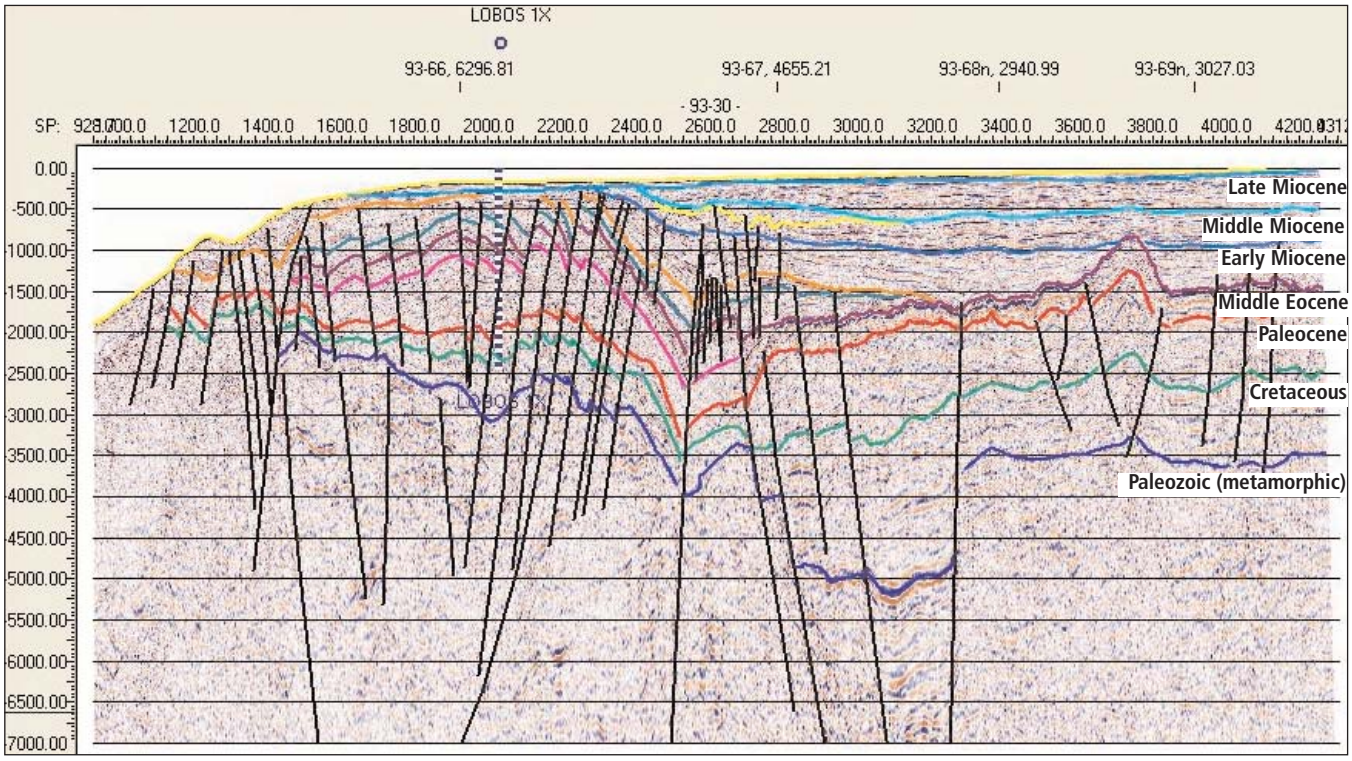
Targets in the Trujillo Basin include turbidite sands. This study has resulted in a better

International Meeting *continued on page 16*

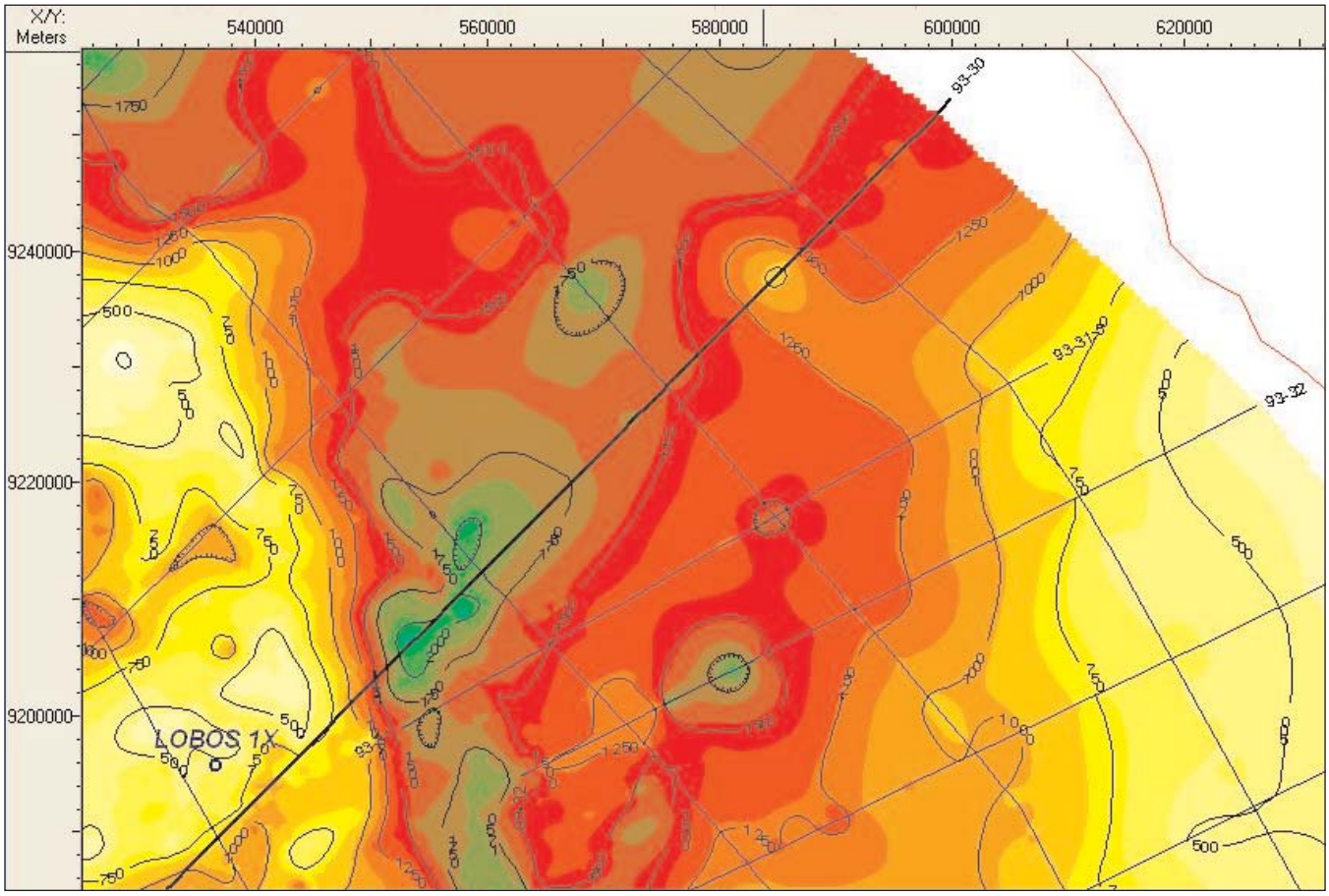
Peru Basins

HGS International Meeting

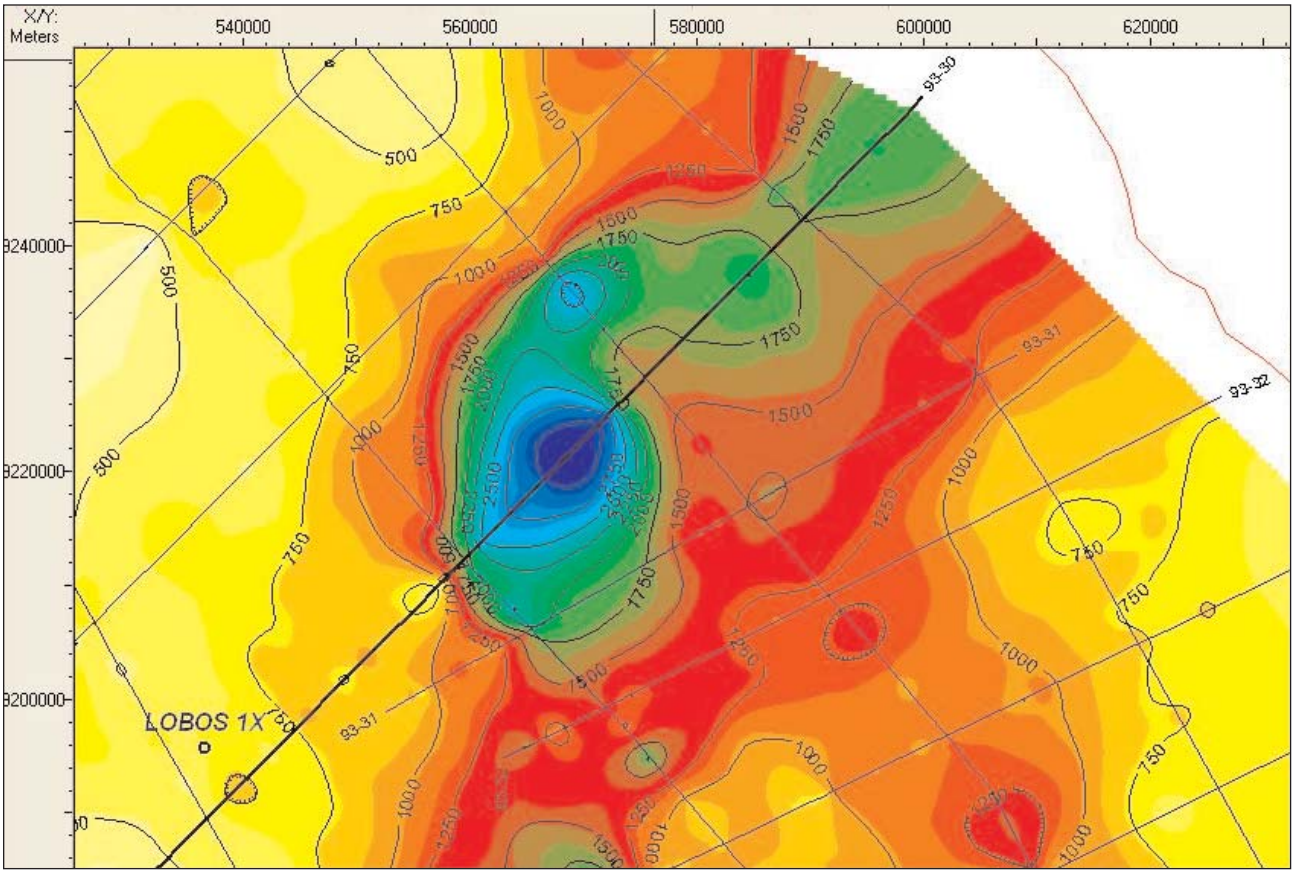
continued from page 15



Depth-converted seismic profile from offshore Peru traversing the Trujillo basin (SP 1400-2400), the Trujillo-Salaverry arch (SP 2600-2800) and the northern part of the Salaverry basin (SP 3000-4200). The profile shows a pop-up structure to the northeast of an extensional basin.



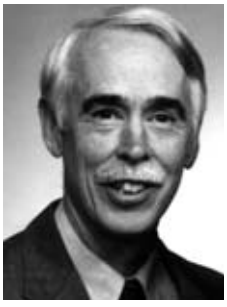
Structure map of the Middle Eocene, inferred from its seismic-stratigraphic signature to be carbonate-prone. The structure map shows the areal extent of a pop-up structure to the northeast of an extensional basin. Spacing between adjacent dip profiles is approximately 20 km so only the largest features show up on this regional grid.



Isopach map from the top of the Middle Eocene to the top of the Paleozoic basement metamorphics, encompassing the basal Tertiary, Paleocene and Cretaceous sections which include coarse siliciclastics (conglomerate and sand) in the Lobos 1X well. The Cretaceous section may include a Muero Fm (equivalent) source interval known to be present to the north in the Talara basin. The Cretaceous section is mature for oil in the subbasin roughly defined by the 2,500 m isopach contour, based on thermal maturation modeling.

understanding of the paleogeography that controlled the distribution of these sands. Cretaceous sandstones in the Trujillo and Salaverry Basins and probable Eocene carbonates in the Salaverry and Pisco Basins may also be prospective. Fractured Paleozoic strata are objectives in the Sechura Basin and perhaps in the other basins as well. ■

Biographical Sketch



Robert Hickman is a structural geologist, skilled in regional tectonic interpretation and analysis of complex structures. His experience includes a long career with Unocal, where he headed the Structure and Petrology group, was a Sr. Research Associate, a Consulting Geologist and Coordinator of Structure and Remote Sensing.

Mr. Hickman has a BS degree in geology from Stanford and a Masters and PhD degrees in geology from the University of Wisconsin.

Currently Bob has his own consulting company, Structural Solution.

HGS CONTINUING EDUCATION COMMITTEE PRESENTS

Applied Geopressure

by

Selim S. Shaker, PhD

*Geopressure Analysis Services (**G.A.S.**)*

Wednesday, October 19, 2005
8 am – 4 pm
Registration Table opens at 7:30 am

Core Laboratories
6316 Windfern
Houston, TX 77040

This course will provide in-depth practice of geopressure concepts, measurements, prediction, analysis, risk and appraisal.

Review and learn about:

- Causes, concepts and definitions of geopressure
- The tools, techniques and tests used for direct and indirect measurements, QC and calibration
- Different prediction methods, mainly based on effective stress
- Techniques used for predictions pre-drilling, during drilling and after drilling
- QC petrophysical properties adequate for pore pressure predictions, especially seismic velocity
- Supra-sub salt pressure models, fault sealing, trap sealing and retention capacities
- Applications for exploration, exploitation and drilling, including compartmentalization, post drilling appraisal and risk assessment
- Several case histories from the Gulf of Mexico will be discussed during this course.

7 Professional Development Hours (0.7 CEU) are earned by attending this course

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Registration Form
Applied Geopressure

Visit www.hgs.org for details and on-line registration. Registration form can be faxed or mailed to the HGS office.

Visit www.hgs.org for details.
Fax (713) 463-9160

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*** Members: $80, if registered by 4:00 PM Friday, October 14; $95 thereafter**
Non-Members: $105, if registered by 4:00 PM Friday, October 14; $120 thereafter

Price includes continental breakfast, box lunch and afternoon snack.

* Membership prices are extended to any member of (circle one): Member Number: _____
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Consider $24 annual dues to join HGS and save $1 off non-member prices: **http://www.hgs.org/join_hgs/join_hgs.asp**

Tuesday, October 18, 2005

The Sofitel Hotel • 425 Sam Houston Pkwy. North
Social 11:15 a.m., Luncheon 11:30 a.m.

Cost: $31 Preregistered members; $35 non-members & walk-ups

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 (include your name, e-mail address, meeting you are attending, phone number and membership ID#).

HGS Northsiders Luncheon Meeting

by ***W. Charles Barnes***
Stone Energy Corporation
Houston, TX

Subsurface Vents Under the Gulf of Mexico Shelf: Characteristics and Significance for Hydrocarbon Migration and Trapping

Mud volcanoes throughout the world erupt with mixtures of mud, brine and hydrocarbons. As the apex of expulsion systems, these features give insight into the process of hydrocarbon expulsion and shale dewatering at depth. Many eruptions are believed to be sourced from overpressured shales lying at great depths.

Subsurface vents may be important point sources of hydrocarbon migration into larger fields nearby

Compact structures observed on seismic data near the top of geopressure appear to be at the root of expulsion systems and are interpreted as "subsurface vents" where fluids are expelled from overpressured shales into the transitional and normally pressured section above. The structures are located downthrown on deeply rooted faults. Collapse topographies surrounding the vents appear to have been created by fluid withdrawal from geopressured shales subjacent and upthrown to the vents. As fluid expulsion is often linked with fault movement, the vertical reach of conducting faults above these vents may be governed by the effective fountainhead of the ascending pressured fluids. Bright spots occasionally stream from these faults and may be evidence of actively migrating hydrocarbons.

The significance of subsurface vents related to petroleum exploration is two fold. First, subsurface vents appear to be almost always charged. In fact, this author has yet to document a case that lacks hydrocarbon accumulations. Additionally, these structures are often filled to the spill point with reserves in the range of 5 to 50 BCF. Second, subsurface vents may be important point sources of hydrocarbon migration into larger fields nearby. A better understanding of these structures and their evolution may aid in predicting hydrocarbon accumulations in neighboring structures and lead to a knowledge of specific migration pathways within a basin. ■

Biographical Sketch

Charley Barnes holds a BS degree from Baylor University and an MS degree from Texas A&M University, both in geophysics. He is an explorationist with experience in the U.S. Gulf Coast, both onshore and offshore. He explored for BP Amoco, Pioneer Production Co., Trinity Resources, Amerada Hess and Apache, before joining Stone Energy in 1999. His focus is on play concept generation, with particular interests in salt and shale tectonics in relationship to petroleum migration and entrapment. Mr. Barnes is a member of AAPG and SEG and recently presented his findings on subsurface vents at the AAPG Convention in Calgary.

Monday, October 24, 2005

HGS North American Explorationists Dinner Meeting

Westchase Hilton • 9999 Westheimer
Social 5:30 p.m., Dinner 6:30 p.m.

Cost: $25 Preregistered members; $30 non-members & walk-ups

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. (include your name, e-mail address, meeting you are attending, phone number and membership ID#).

by ***W.C. Riese*** *(speaker)* ***and W.L. Pelzmann***
BP America Production Co., Houston, TX
Glen T. Snyder
Rice University, Earth Science Department
Houston, TX
G.K. Arp
Booze Allen Hamilton, Las Cruces, NM

New Insights on the Hydrocarbon System of the Fruitland Formation Coalbeds, San Juan Basin

The Fruitland Formation is the world's largest known and most productive coalbed methane deposit, with 45 TCF of gas. This important hydrocarbon system originates from a unique combination of depositional environments, tectonic framework, and structural and landscape evolution. This system is more complex than recognized by previous workers. The presence of biogenic gas in the formation is recognized, and is thought to indicate contemporary meteoric recharge of the formation. We conclude recharge of the regolith is taking place, but that biogenic methane is probably sourced by microbes introduced to the formation 35 to 40 million years (Ma) ago.

Our work finds that seep activity varies on a thirty-year cycle. We attribute this cyclicity to variations in the frequency of magnitude-3 or greater earthquakes

Previous discussions of the coal hydrology focused on meteoric waters thought to be recharging the coals today. Our work indicates that four distinct waters are present in the coals. Connate waters fill the formation in the center of the basin. Meteoric recharge is restricted to coal and regolith no more than a few kilometers from the outcrop. Meteoric water found farther down dip is fossil meteoric water and reflects recharge between 35 and 40 Ma. Waters from deeper formations also locally recharge fractures in the coals.

The Paleozoic architecture of the basin continues to influence fluid flow in the coals. Fractures or faults in the coals may be contributory to the high permeabilities found in the high-rate fairway, a cluster of wells with larger recoverable reserves that produce at rates of up to 10,000 MCFPD; the structure could also explain the fairway's abrupt southern boundary. The Cenozoic Rio Grande rift event imposed a second fracture set. Intersection of these fracture sets with the outcrop provides the locus for most methane seeps.

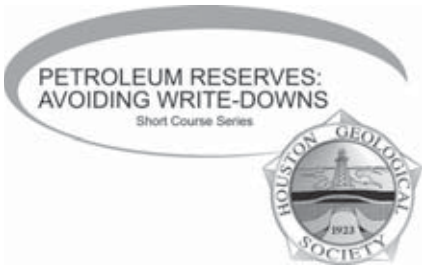
Methane seeps at the coal outcrop have been active for decades. The presence of these seeps is due in part to continued weathering and breaching of biosome-scale reservoir compartments, a process which is more rapid along fracture systems. Our work finds that seep activity varies on a thirty-year cycle. We attribute this cyclicity to variations in the frequency of magnitude-3 or greater earthquakes, which also varies on a thirty-year cycle. The epicenters of these quakes closely correspond with the areas of most active seepage. As such, pulses in seep activity are due to the result of releases from deeper reservoirs whose seals are periodically breached. ■

Biographical Sketch

Rusty Riese has a BS in geology from the New Mexico Institute of Mining and Technology, and MS and PhD degrees from the University of New Mexico. He has approximately 35 years of experience in the petroleum and minerals industry as well as in government having worked for the New Mexico Bureau of Mines, Gulf, Anaconda, ARCO, Vastar and BP. Through his career he has worked in exploration geology and geochemistry in both management and line positions. He also holds faculty positions at several universities, including Rice University, where he has taught petroleum industry economics and petroleum geology for more than 20 years. He is presently employed as a Geoscience Advisor with BP America.

The Houston Geological Society

Continuing Education Committee Presents the First HGS Digital Publication:



Part I:
AN OVERVIEW OF RESERVE DEFINITIONS AND REPORTING REQUIREMENTS
John E. Hodgin and Thomas Wagenhofer, Ryder Scott Company, L.P.

Part II:
AN OVERVIEW OF RECOMMENDED GEOLOGICAL PRACTICES
Daniel J. Tearpock, Subsurface Consultants & Associates, L.L.C.

Part III:
AN OVERVIEW OF RECOMMENDED ENGINEERING PRACTICES
William M. Kazmann and Edward P. Travis, LaRoche Petroleum Consultants, LTD

Part IV:
AN OVERVIEW OF RECOMMENDED PETROPHYSICAL PRACTICES
Bill Price, Petrophysical Solutions, Inc.; John Kulha, Consultant; Ted Griffin, Core Lab
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Wednesday, October 26, 2005

Petroleum Club • 800 Bell (downtown)
Social 11:15 a.m., Lunch 11:45 a.m.

Cost: $30 with advance reservations, $35 for walk-ins, space available ($15 for Emeritus and Honorary).

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HGS General Luncheon Meeting

by ***Todd Greene*** *(speaker),* ***Brian O'Neill, Peter Gamwell, Todd Butaud, Andrew Pink, Michael Golden, David Jones, James Parr, Michael Taylor and Istvan Barany***
Anadarko Petroleum Corporation
The Woodlands, TX

Depositional Model for Deepwater Miocene Reservoirs in the Jubilee and Spiderman Gas Fields, Eastern Gulf of Mexico

Accurately predicting how fluid will flow through the reservoir in order to characterize the degree of compartmentalization and to locate the position of flow baffles and barriers is a critical factor in making sound economic decisions during field development. Devising a good reservoir characterization model for deep-water sands, as a fundamental framework to a reservoir simulation model, can improve our ability to predict how the reservoir will perform over the life of the field. Defining the internal geometry of geobodies and relating them to calibrated rock properties is critical to 3D reservoir characterization. However, predicting how fluid will flow during production becomes very challenging for those areas remote from well control in a field that has sparse well penetrations and where the wells are often spaced thousands of feet apart.

Our team interprets a basin-floor setting, where the stratigraphic architecture reflects the interplay of a variety of deep-water depositional processes

To address this uncertainty, we were able to utilize all available data, including high-resolution seismic, wireline log analysis and whole core data, to develop a 3D facies-based model that distributes petrophysical properties (porosity, permeability, water saturation, shale volume) with statistical ranges of uncertainty throughout the volume of the field. The model can then be scaled up to a dynamic scale appropriate for reservoir flow simulation that will ultimately be calibrated to field production data.

We present the depositional facies model for two newly discovered Miocene-age deep-water gas fields in the eastern Gulf of Mexico: Spiderman and Jubilee Fields, De Soto Canyon (DC) Blocks 620/621 and Atwater Valley (AT) Block 349 respectively (Figure 1). Data collected from 180 feet of whole core from the Spiderman Field and 90 feet of core from the Jubilee Field has strongly influenced interpretation of the reservoir architecture.

At both fields, our team interprets a basin-floor setting, where the stratigraphic architecture reflects the interplay of a variety of deep-water depositional processes, including high-density sandy turbidite flows, suspension deposits, mass transport complexes, low density turbidites and channelized deposits. The irregular sea floor created by Miocene erosional mass

HGS General Luncheon Meeting *continued on page 25*

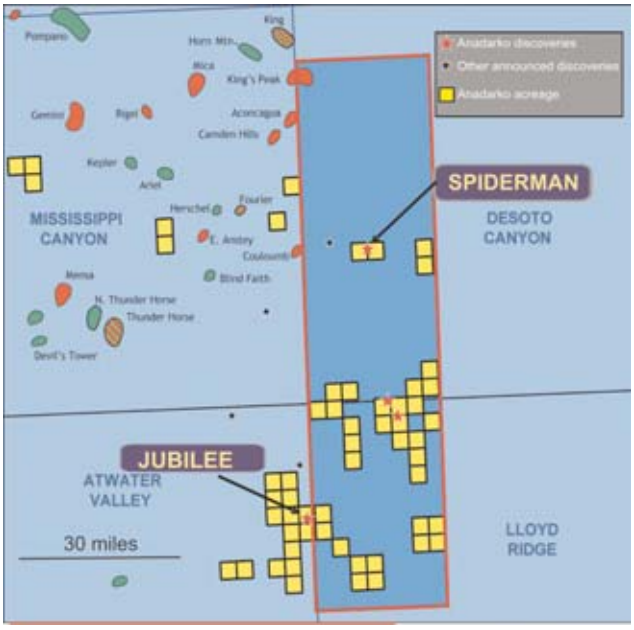

Figure 1. Location map of eastern Gulf of Mexico oil and gas fields, showing the location of the Spiderman (DC 620/621) and Jubilee Fields (AT 349).

"Coastal Subsidence, Sea Level and the Future of the Gulf Coast"

November 3–5, 2005

Photo by A. E. Berman, San Luis Pass, Texas

A Conference to increase awareness of subsidence issues facing the Gulf Coast Region

Sponsored by: Houston Geological Society and Engineering, Science & Technology Council of Houston

November 3, 4, and 5, 2005 - 8:30 am - 5:30 pm • Registration Table opens at 7:30 am

Northwest Forest Conference Center
12715 Telge Road • Cypress, Texas 77429 • Map available at HGS website
7 Professional Development Hours (0.7 CEU) are earned by attending each day of this conference

Visit www.hgs.org for details. Registration form can be faxed or mailed to the HGS office.
Houston Geological Society, 10575 Katy Freeway, Suite 290, 10575 Katy Freeway, Suite 290, Houston, Texas 77024
713-463-463-9476 Fax (713) 463-9160

Please complete registration amounts and total. Payment is due at the time of registration. Prices include continental breakfast and lunch.

REGISTRATION FEES:	Before Oct. 27	Oct. 27 or Later	Reservation
All Three Days	$150.00	$180.00	
Thursday Night Banquet	$30.00	$40.00	
Thursday (one day) Only	$80.00	$100.00	
Friday (one day) Only	$80.00	$100.00	
Thursday and Friday (two days) Only	$130.00	$160.00	
Field Trip Only	$30.00	$40.00	
TOTAL PAYMENT			

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HGS General Luncheon Meeting continued from page 23

transport complexes, along with deeper episodic salt movement, also played an important role in the lithofacies distribution of these deposits.

The Spiderman Field (DC 620/621) is located in 8,100 feet of water. The total depth of the cored well is 17,210 feet true vertical depth (TVD). The shallowest interval, termed the MM9 (Middle Miocene) sequence, contains three interconnected, stacked sand bodies that were deposited in a confined, amalgamated sand-filled low-relief channel complex. The deepest interval, termed the MM7 sequence, also appears interconnected and was deposited as more unconfined sheets within a frontal splay complex that was then overlain by a channel/levee complex.

The Jubilee Field (AT 349) is located in 8,830 feet of water. The total depth of the cored well is 17,800 feet TVD. Three interconnected stacked sand bodies, termed the UM1b (Upper Miocene), were deposited as compensatory stacked, amalgamated and layered sheets that are overlain by erosive mostly mud-filled channels. ■

Acknowledgments

The authors wish to thank Anadarko Petroleum Corporation for allowing us to publish this material. We are grateful to WesternGeco, owners of the seismic data, for permission to present the seismic images. We also wish to thank Spiderman Field partners Dominion Exploration and Production and Spinnaker Exploration for granting permission to release data.

Biographical Sketch

Todd Greene has a BS degree in earth sciences from the University of California at Santa Cruz and a PhD in geological sciences at Stanford University. His dissertation focused on tectonics, sedimentology, organic geochemistry and petroleum systems of the Turpan-Hami basin of northwestern China. He is currently employed as a senior geologist at Anadarko, where he is part of a petroleum systems geoscience technology team consulting on a number of sedimentologic and stratigraphic projects in the deepwater Gulf of Mexico, mid-continent, and a variety of international arenas.

Past Presidents Luncheon

Standing from the left: Cy Strong 91–92, Jim Ragsdale 96–97, Sabin Marshall 74–75, Matt Daura 83–84, Craig Moore 00–01, Peggy Rice 82–83, John Amoruso 72–73, Steve Levine 04–05, John Biancardi 93– 94, Craig Dingler 03–04, Jack Colle 1954,

Seated from the left: Ron Harlan 90–91, Jeff Morris 78–79, Dan Smith 87–88, Orville Lundstrum 63–64,

Standing from the left: Chuck Noll 86–87, Ron Nelson 94–95, Dean Grafton 77–78, Ben Sorrell 73–74, Chet Baird 80–81, Jim Lewis 68–69, Dick Bishop 89–90

Seated from the left: Denise Stone 02–03, Paul Hoffman 01–02, Tony Reso 75–76, Charles Sternbach 99–00

Making Tracks on the Paluxy River

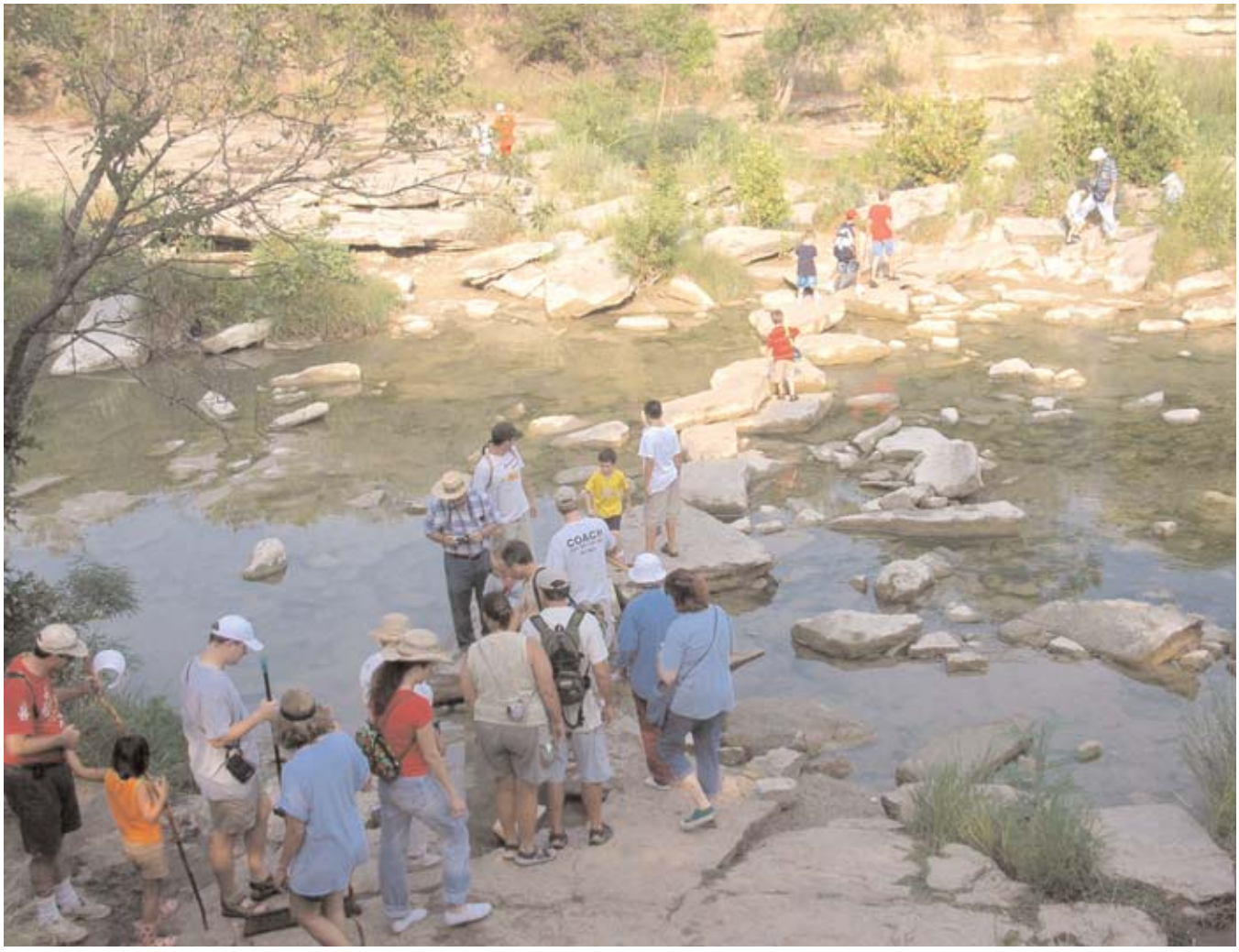
*by **Neal Immega,** HGS Field Trip Committee*

Possible Acrocanthosaurus *footprint in the Paluxy River.*

This year's first joint field trip with the Houston Geological Society and the Houston Gem and Mineral Society was a complete success. Our leader for this activity was Glen Kuban, who has been publishing on trackways in general and the Paluxy River dinosaur tracks in particular. Even after the pillaging of the Glen Rose trackways by New Yorkers in the 1930s, Dinosaur Valley State Park and environs are still among the best places in the world to see theropod and sauropod trackways.

All the guidebooks have been telling you this for years—"you need a native guide to see the sights"—and Glen was ours. I bet you have been to the park and thought that most of the tracks had been collected 70 years ago. Not true. Glen took us to

Making Tracks *continued on page 33*



A real family friendly trip.

October 2005

Sunday	Monday	Tuesday	Wednesday
	Reservations: 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.**		
2	3	4 **HGS Executive Board Meeting**	5
9	10 **HGS General Dinner Meeting** by F. Yip, J. Pear, and P. Siegele *"The Subsalt Tahiti Field Discovery, Green Canyon 640: Opening Another Deepwater Frontier"* Page 11	11	12 Earth Scie
16	17 **HGS International Dinner Meeting** by R. Hickman *"Basins of Offshore Peru: New Exploration Framework and Plays"* Page 15	18 **HGS Northsiders Luncheon Meeting** by W.C. Barnes *"Subsurface Vents Under the Gulf of Mexico Shelf: Characteristics and Significance for Hydrocarbon Migration and Trapping"* Page 19	19 **HGS Course** by S. Shaker "Applied Geopressure" *8:00 a.m., Core Laboratories* *Page 18*
23 30	24 **HGS North American Dinner Meeting** by W.C. Riese, W.L. Pelzmann, G. T. Snyder and G.K. Arp *"New Insights on the Hydrocarbon System of the Fruitland Formation Coalbeds, San Juan Basin"* Page 21 31	25	26 **HGS General Luncheon Meeting** by T. Greene, B. O'Neill, P. Gamwell, T. Butaud, A. Pink, M. Golden, D. Jones, J. Parr, M. Taylor and I. Barany *"Depositional Model for Deepwater Miocene Reservoirs in the Jubilee and Spiderman Gas Fields, Eastern GOM"* Page 23


GeoEvents

Thursday	Friday	Saturday
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6	7	8 Family Earth Science Festival at HMNS Page 37 ESW Volunteers Needed Page 37
13 nce Week	FYI If your mailing label says EXPIRED this is your last issue.	15 Earth Science Week Field Trip Page 37
20 SIPES Luncheon Meeting by R. Moore *"Read It and Weep"* Page 39	21	22 NOW you can make your reservations on-line at www.hgs.org
27 CAST 2005 Page 6	28 HGS/GSH Shrimp Peel Sam Houston Race Track 6 p.m. – 10 p.m. Page 40	29

Upcoming GeoEvents

November 3–5
HGS/ECH Conference "Coastal Subsidence, Sea Level and the Future of the Gulf Coast" *Page 24*

November 6–9
SEG Convention
George R. Brown Convention Center

November 10
HGS, SPE, SIPES, HEC Joint Luncheon

November 12
Houston Gem and Mineral Society Field Trip – Whiskey Bridge
281-530-0942 or field_trip@hgms.org

November 14
General Dinner

November 15
Northsiders Luncheon
"The New Carbon Sequestration in the Gulf Coast: Geologic and Engineering Support in its Development"

November 15
Environmental & Engineering Dinner

November 17
SIPES Luncheon
"Beware of Global Cooling"

November 21
International Dinner
"R. E. Sheriff Lecture: Martian River Deltas and the Origin of Life"

December 4–7
25TH Annual GCSSEPM Foundation Bob F. Perkins Research Conference *Page 48*

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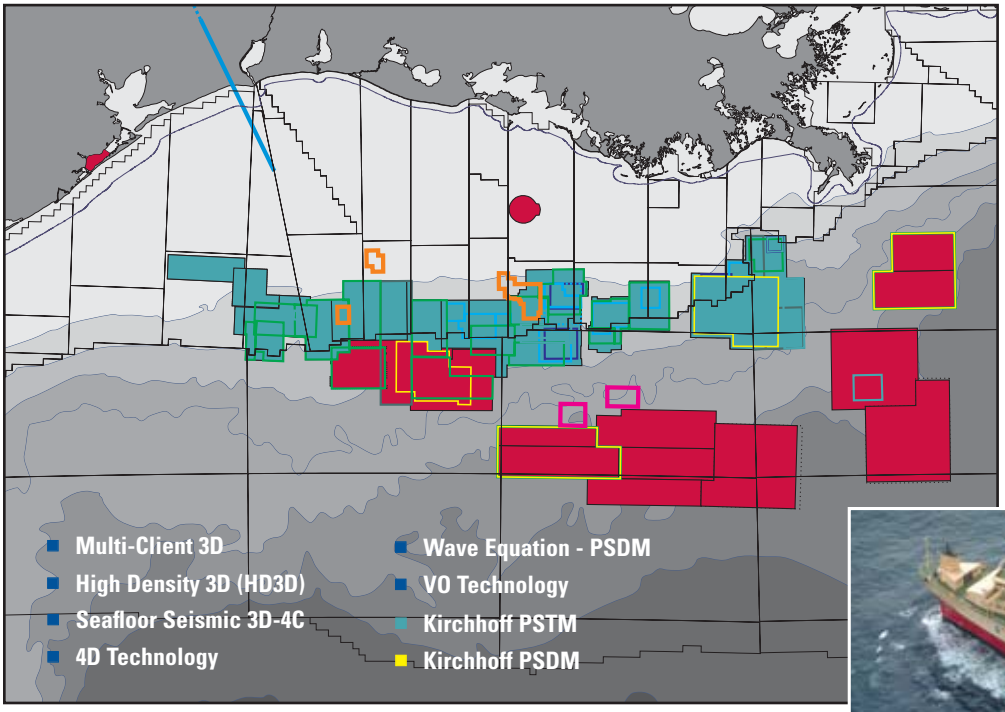

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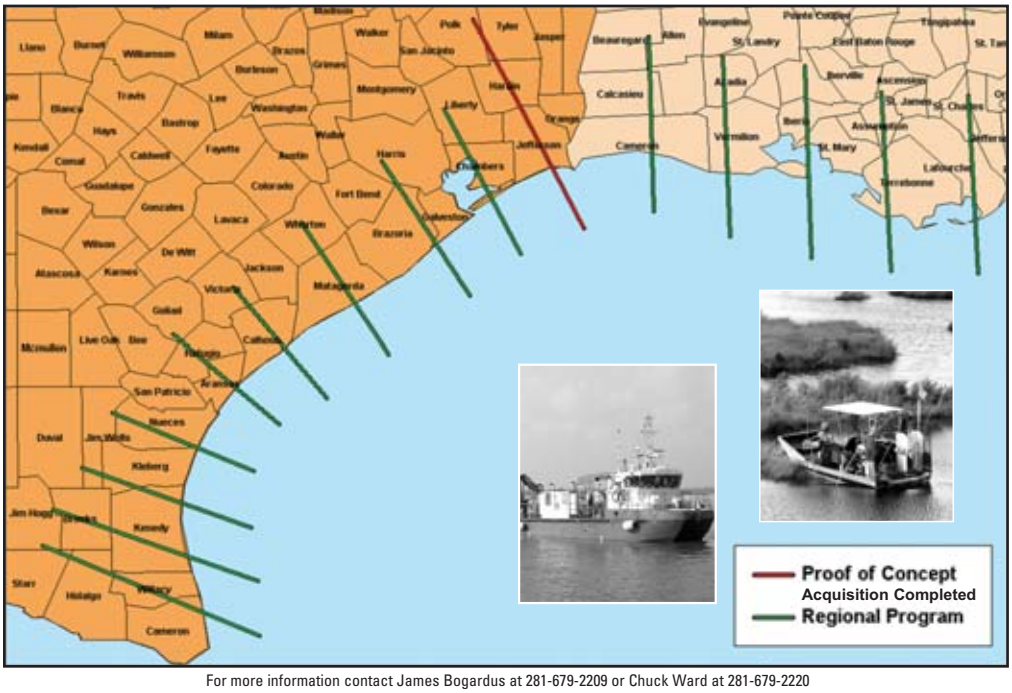

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Making Tracks on the Paluxy River

continued from page 28

trackways that run for more than 30 steps down the river. He showed us tracks where the fillings are harder than the tracks and so the tracks stand in relief! He even showed us the real story behind the disputed "Paluxy Man Tracks." Glen has worked with the Parks people for so long that we were given extraordinary access, taken through back gates and across fields to reach prime areas.

Something for all ages.

Field trip leader, Glen Kuban, holding up a uneroded "Paluxy River Man Track"

We got many strange looks from other visitors when we descended to the river level and started to clean the riverbed with our brooms. The negative-relief trackways collect sediment and frequently are covered by luxurious blooms of algae. Though it looks like King Canute sweeping back the sea, this process really works to make the tracks visible. The river flow quickly clears the area of stirred up sediment.

One of the great benefits of doing the field trip, literally in the river, is that the children had a great time playing in the water, and providing small feet for scale in the pictures. The tracks look ever so much bigger with a kid-sized foot for scale.

We got to see a string of tracks where some are so eroded that they look like they were made by a really huge human foot. In the same string are some uneroded tracks where you can see that the elongation of the track is from the dinosaur heel (metatarsal). Theropods normally walk on their toes, but sometimes their heel comes in contact with the ground (bad posture? flat feet? tired?). In this case, the sediment was so soft that it filled in the claw marks, which become "toes" on an eroded track.

The Houston Gem and Mineral Society and the Houston Geological Society have many members in common and have similar interests in seeing geology in the field. Check out the www.hgms.org web site to see the kinds of things that rockhounds do and get back to your roots. I became a geologist because I enjoyed rockhounding as a child. ■

Glen sweaping back the tide, or removing mud from a trackway.

Earth Science Education—Get in on the Ground Level

by ***Neal Immega***

I bet you've read about all the hand-wringing going on over the status of earth science in the educational curriculum of the Texas schools. Houston has more earth science professionals than any place on the planet, yet no one teaches earth science in the schools. You probably also read claims about how the teachers just teach the TEKS (Texas Essential Knowledge and Skills) test and that no one learns anything else. You are probably even more familiar with your sky-high school taxes and the perennial complaints by the school board that schools do not have enough money to do anything. The last straw is that though every expert on the subject has been to Austin to testify about one thing or another, nothing changes very fast.

Don't wash your hands of the whole problem; do something about it.

The Houston Gem and Mineral Society (HGMS) has been making geology specimen collections for the school system for years. The scheme works this way: A member who gives a talk at a school (anywhere, public or private), may leave behind two of the collections. If you want to see what the collections look like, go to www.hgms.org and visit the K-12 education page. There are collections of basic paleo and basic minerals, minerals from around the world, and a "field trip in a box."

About 70% of the material is collected by HGMS members, and they also assemble the kits, write up the descriptions and compose TEKS-related questions. The remainder of the materials and the packaging are purchased using a $2,500 yearly grant from ConocoPhillips. The project is always in need of materials: For example, to start building a rock cycle collection, the group needs such simple things as a conglomerate made of pea-sized pebbles, sandstone, phyllite, garnet schist and gabbro. Pieces that are 2 by 2 or 2 by 3 inches are ideal. We need "mine run" pieces. If you want to help (and clean up the pile of rocks in your garden at the same time), please see www.hgms.org for the current wish list. Let me know if you have a locality that has materials we need. Some Saturday, come to our shop and see what we are doing, and bring a bucket of rocks for us.

Get involved. There is much you can do on every level: give talks; join HGMS and start leaving collections behind when you give a talk; help build collections; or donate some of the specimens that are needed. Don't get frustrated by the bureaucrats in Austin. You can make a difference without solving the entire problem—just fix the one closest to hand. ■

Geoscientists Explore Our Earth

Earth Science Week
October 8–15, 2005
Family Earth Science Festival Schedule of Events

Houston Museum of Natural Science
Saturday October 8, 2005, noon–4:30 pm
Join us for the Family Earth Science Festival at the Houston Museum of Natural Science's Weiss Energy Hall. The festival will include an energy passport contest, hands-on demonstrations, special presentations, Boy Scout badge activities, and programs. We will have an opening ceremony for Houston's Earth Science Week in the museum at 1:00 pm. Please join us as a visitor or a volunteer, and bring your family and friends! Please visit the museums website at www.hgms.org for more information or contact Inda Immega at immega@swbell.net or Martha McRae at mmcrae1@houston.rr.com

Classroom Connections- Art and Essay Contest
October 8, 2004
By popular demand we are offering our second annual art and essay contest. This contest is for two groups: K-5 and 6-8 graders from classrooms around Houston. The theme of the contests will be the national theme "Geoscientists Explore Our Earth." First, second, third and honorable mention winners will be selected from each category and will be awarded a prize and certificate at the Family Earth Science Festival on October 8. For more information, please contact Jennifer Burton at jennifer_burton@anadarko.com

To learn more about national contests please go to http://www.earthsciweek.org/index.html, where Earth Science Week kits, which include posters, are available from the AGI.

Come Join Us on a Field Trip!
Fossils at Whiskey Bridge
Saturday, October 15, 2005 11:00 am–3:00 pm
An ever popular venue, on Saturday we will be looking for fossils at the Stone City bluffs on the Brazos River, popularly known as the Whiskey Bridge outcrop. It's located on the south bank of the Brazos River at the Highway 21 bridge, southwest of Bryan-College Station. It is a fabulous place to see and collect Eocene fossils from the green glauconite sand. The Eocene Crockett Formation was deposited on the outer continental shelf in about 300 feet of water and has a very diverse fauna included in the sediments. Snails and bivalves are very common. You are likely to find corals, bryozoans, worms, crab claws, shark teeth and otoliths (fish ear bones). The outcrop area is huge.

There is plenty of parking on the south side of the bridge; the HGS will be set up on the west side of Highway 21. We will have people at the top to give you an idea of what you are going to see and people on the outcrop to explain what you are seeing. Plan to arrive any time between 11 and 2; groups will be organized continuously and we'll be there until 3 pm.

For more details contact Earth Science Week chair Martha McRae at mmcrae1@houston.rr.com or co-chair jennifer_burton@anadarko.com

We Need Volunteers for all of these Events

If you or someone you know may be interested in helping please contact us. Museum Day always needs volunteer docents to help with set-up, break-down and with assisting visitors on their questions about logistics and most importantly the geology they are experiencing. We need judges for the art and essay contest. We received over 300 entries last year so we need creative people to help us pick the best entries. The end-of-week field trip is always a huge draw and we need volunteer paleontology lovers to help the public locate and understand the fossils and strata they are seeing. Don't worry! We will help you with the background information. It is truly rewarding; come on out!!! ■

Thursday, October 20, 2005

Petroleum Club • 800 Bell (downtown)
Social 11:30 a.m., Lunch 11:45 a.m.

Cost: $30 for members and affiliates pre-registered by 12 noon Tuesday 13th June (No-shows will be billed.). $35 for non-members, guests, and walk-ups.

Make reservations by telephone (713-651-1639), Fax (713-951-9659), Web-site (www.sipes-houston.org), or e-mail (bkspee@aol.com) to B.K. Starbuck-Buongiorno by 12 noon Tuesday before the meeting.

SIPES
Luncheon Meeting

*by **Ronald L. Moore,** Atty*

Read it and Weep

Well-written agreements are those which keep the agreeing parties out of court. Often the spirit of an agreement relies too heavily on ethical guidelines to make it work. In this presentation, Ron Moore will share his experience and observations on how ethical guidelines can be strained in agreements between a Big Company, a Prospect Generator, and a Prospect Screener. He will use a court case to illustrate his message. Issues to be addressed include:

Who do you sell a deal to?
How hard do you try and for how long?
How do you protect yourself? and,
Read everything and do not sign any document that could cost you your deal.

Sometimes the Prospect Screener's need for protection makes that party an inappropriate prospect participant. When is the time right to give appropriate notices and disclaimers? ■

Biographical Sketch

Ronald L. Moore, President of the law firm Ronald L. Moore, P.C. Mr. Moore is a native Houstonian who has practiced oil and gas law since 1974. He specializes in the review and preparation of documents related to exploration and production of oil and gas prospects, for the purchase and sale of oil and gas properties, for the examination of title and for preparation of title opinions. He represents clients in business disputes and is a frequent lecturer to industry audiences on oil and gas law for the small operator, investor and consultant.

Mr. Moore was admitted to the State Bar of Texas in 1974, and to the Louisiana State Bar in 1976. He was also admitted to practice before U.S. District Court for the Southern District of Texas and the U.S. District Court for the Western District of Louisiana. Mr. Moore was among the first group of attorneys to be certified in 1986 by the Texas Board of Legal Specialization to practice Oil, Gas and Mineral Law. He received a BA degree with Honors and a Doctor of Jurisprudence degree from the University of Texas.

He has held numerous offices in the Oil, Gas & Mineral Law Section of the Houston Bar Association and was its chairman in 2000. He is a member of the Houston Association of Professional Landmen.

HGS Insignia Was Designed in 1949

The official insignia of the society was adopted in 1949. At Phil Martyn's insistence, an emblem contest was started to provide the society with an official insignia. On January 29, 1949 the late Walter J. Osterhoudt was named the winner of the contest. The HGS emblem is best described in his own words.

"The oil derrick is firmly established upon the Gulf Coast plain overlooking Galveston Bay, through which passes much of the oil to the markets of the world. Beyond Galveston Bay is the Gulf of Mexico, a new province, which challenges geologists and geophysicists to almost unlimited new reserves. Under the oil derrick is a cross section of a typical Gulf Coast salt dome. The words *Houston Geological Society* are arranged upon a circle which is symbolical of the world, because our geologists come from and travel to all places on the earth in search of oil and other minerals. The five points of the design are a pleasant reminder that we, the members of the society, are privileged to live in Texas. The 1923 is the year in which the society was organized."

H G S / G S H

Shrimp Peel

Friday, October 28, 2005 6pm - 10pm

at

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> Enter through North gates
> Valet parking available
> Tickets mailed to address on form
> Pay with check or credit card
> Order by Oct. 20 - No refunds

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HGS Hurricane Katrina Assistance Program

by the ***HGS Community Outreach Committee***

The HGS solicits immediate participation from all HGS members! There will be a Sign-Up Table adjacent to the registration table during the upcoming lunch and dinner meetings. *YOU CAN HELP.*

Open Your Checkbooks!

HGS will continue to accept financial contributions to assist the American Red Cross, Houston Food Bank and the Salvation Army.

Open Your PDA's and Daytimers!

HGS is recruiting members in order to build a database of volunteers for Hurricane Katrina Related Assistance. Over the next several months HGS, as an organization, will sponsor some of the following:

- Clothing Drive/Clothes Sorting — day or full day
- Houston Food Bank — day or a full day
- Assisting the American Red Cross Effort at Reliant Park, George R. Brown, where ever our help is needed

Open Your Homes and Offices!

We are developing *free temporary housing* for displaced individuals and families who are HGS members, AAPG members or members of the New Orleans Geological and Geophysical Societies from the affected areas. If you are willing to share your home or a vacation home with a displaced individual or family, please contact a member of the HGS Community Outreach Committee listed.

We are also developing *free temporary office space* for small companies and independents so they may continue their operations. If you are willing to share your office or know of some one who may be willing to share extra office space, please contact a member of the HGS Community Outreach Committee.

To help on the committee, and/or to volunteer contact the HGS office directly at 713.463.9476; go to the HGS Community Outreach Committee Website Link or contact any of the individuals listed below.

Walter Light	713-823-8288	wthunderx@aol.com
Cindy Gillespie	832-969-4385	clgillespie@sprintpcs.net
Paul Babcock	713-859-0316	pbabcock@pecorp.com
Steve Levine	281-293-3896	steve.d.levine@conocophillips.com
Dave Rensink	713-296-6332	dave.rensink@apachecorp.com

Displaced HGS members—remember to update your contact info online at hgs.org. Please send any contact info or announcements you wish to have published in the *Bulletin* to editor@hgs.org.

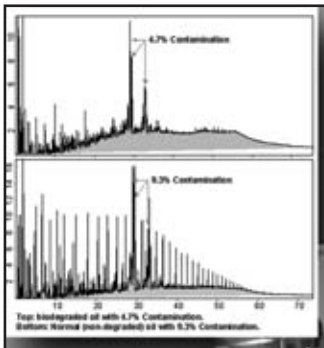
Call for Candidates to the AAPG House of Delegates

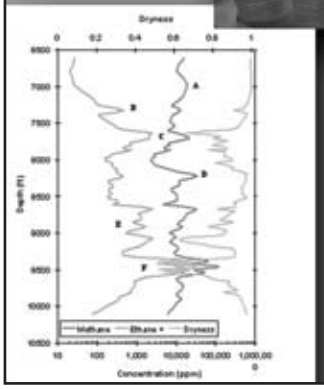
Houston candidates are now needed to run for the office of AAPG delegate in the election to be held in early 2006.

If you are interested in having a leadership role in the business and future course of AAPG by contributing your ideas and your voice toward AAPG's business agenda, consider running for Delegate. This service role offers opportunities for networking and making a meaningful impact on the continuing efforts of AAPG. If you would enjoy representing your colleagues to AAPG—and representing AAPG to your colleagues—this role is for you.

The House of Delegates is the legislative body of AAPG. Delegates participate in the legislative process during the annual meeting of the entire House of Delegates at the AAPG Annual Convention. During their three-year term, Houston Delegates meet at monthly luncheons to network, process new member applications and manage the business issues at hand. The group is fun and energetic and many companies, geoscience roles and practices are represented.

New candidates with fresh ideas and viewpoints are welcome. If you are interested in running, please contact Steve Levine (steve.d.levine@conocophillips.com 281-293-3896) or Martha Lou Broussard (mlbrou@rice.edu 713-665-4428). ■





Government Update

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

News from the 79th Legislature

Groundwater Districts (HB 1763)

Legislation establishes uniform hearing procedures and notice requirements for groundwater conservation districts for rule-making and permit applications. These districts are authorized to adopt rules and issue permits necessary for managing groundwater resources within their boundaries. Texas currently has 83 groundwater districts. Another four districts have been created but not yet confirmed, and an additional seven were created this year in legislation. The bill also addresses management planning by directing districts in the same groundwater management area to manage shared aquifers uniformly and by requiring joint management planning among neighboring districts. The Texas Commission on Environmental Quality (TCEQ) may take action against a district to compel joint management.

Petroleum Storage Tanks (SB 485, SB 1863, HB 1987)

The legislation extends the petroleum storage tank (PST) reimbursement program for eligible parties who have met the statutory deadlines fro cleaning up leaking PSTs. Now, all remediation work must be completed by September 1, 2007, a two-year extension. The final date for the TCEQ to reimburse parties conducting corrective actions at a PST site will be August 31, 2008, if the applicant made a good faith effort to complete the clean-up requirements by the original September 2005 remediation deadline. When applicants cannot complete all corrective actions by the 2007 deadline, those sites will be placed in the TCEQ's PST State-Lead Program. Under this program, state contractors conduct remediation at PST sites not addressed by the tank owners or operators.

Leaking PSTs that were discovered and reported by late 1998 are covered by the remediation fund. As of this spring, about 24,000 leaking PST sites, mostly at gasoline stations, had been reported to the TCEQ. Cleanup had been completed at about 19,800 sites, and remediation was under way at about 4,200 sites. For the total reported, almost 9,000 sites have affected groundwater. The TCEQ oversees remediation at these sites until cleanup is completed.

Dry Cleaners (HB 2376)

As a result of legislation in 2003, the TCEQ began collecting fees for a new remediation fund designed to help pay for the cleanup of contaminated dry cleaner sites. The fees are associated with the annual registration of facilities and the sale of perchloroethylene and other dry cleaning solvents. As of May 31, 2005, about 1,840 dry cleaning facilities and 1,280 drop stations had registered with the TCEQ, and roughly $10 million had been collected for the fund. About 19% of registered facilities have opted out of the remediation fund, saying they never used perchloroethylene. The TCEQ is assessing about 30 sites to determine whether remediation is required. The follow-up legislation made a number of adjustments and clarifications, such as allowing the registration fees to be paid quarterly and extending the deadline to February 28, 2006, for dry cleaners to opt out of the fund. Also, distributors of solvents will be required to register with the agency.

Funding for TCEQ Programs

The TCEQ's revenue structure undergoes a major change in the 2006–2007 appropriations bill. General revenue will drop significantly in the next biennium, though overall funding will actually be higher. The Legislature set general revenue at about $9.6 million, compared with $46.6 million for the biennium ending August 31, 2005. The decrease will be offset by an appropriation from fund balances in the Water Resource Management Account, in which water program fees are deposited. Traditionally, the majority of the TCEQ's general revenue has been used to support agency water programs. Overall, the TCEQ appropriations were set at about $976 million for the next two-year cycle, an increase from the 2004–2005 level of $931.4 million. As with most state agencies, the TCEQ will be required to trim full-time equivalents by 2%, or about 60 staff positions. Significant revisions include:

- PSTs: nearly $66 million increase to continue the cleanup and reimbursement program two years beyond the current expiration date. A supplemental appropriations bill allotted an additional $25 million for the 2005 fiscal year.

- Low-level radioactive waste: an additional $750,000 for activities related to the licensing of a proposed disposal site in West Texas.

- River Compact Commission: $650,000 transfer in general revenue to support and manage the functions of this agency, as spelled out in a memorandum of understanding.

- Title V air permitting: $7 million cut in anticipation of reduced fee collections.

- Low-income vehicle repair assistance: $12 million reduction in the repair program for high-emitting cars and trucks for a projected biennial total of $8 million, which matches expenditures over the last two fiscal years.

Texas Board of Professional Geoscientists News

In its August 2005 meeting, the TBPG passed a requirement for companies to register as a Registered Company Performing Geoscience services. Details will follow after development. This was the result of existing statutory guidelines and enforcement becoming proactive. The TBPG requests that violations be reported to it; the more details regarding the violation, the better. The TBPG will review all **Government Update** *continued on page 45*

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information submitted and has investigative capabilities as well. To check on what violations may be, see the TBPG web page at www.tbpg.state.tx.us.

Notice of Availability of the Draft July 2005 Update to the Water Quality Management Plan

The TCEQ draft July 2005 Update to the Water Quality Management Plan for the State of Texas (draft WQMP update) is now available. The WQMP is developed and promulgated in accordance with the requirements of the Federal Clean Water Act, §208 and includes projected effluent limits of indicated domestic dischargers useful for water quality management planning in future permit actions. Once the TCEQ certifies a WQMP update, the update is submitted to the United States Environmental Protection Agency (EPA) for approval. For some Texas pollutant discharge elimination system (TPDES) permits, the EPA's approval of a corresponding WQMP update is a necessary precondition to TPDES permit issuance by the TCEQ. The draft WQMP update may contain service area populations for listed wastewater treatment facilities and designated management agency information. A copy of the draft July 2005 WQMP update may be found on the commission's Web site at http://www.tnrcc.state.tx.us/permitting/waterperm/wqmp/index.html.

Railroad Commission News

Temporary Water Right Authorizations Required from the TECQ

The TCEQ has requested that the Railroad Commission (RRC) post this advisory notice concerning use of surface water in association with oil and gas activities:

Water flowing in Texas creeks, rivers, and bays is state water or "waters of the state." Under Section 11 of the Texas Water Code anyone who diverts water must have authorization - or water right - from the State of Texas through the TCEQ. Persons who withdraw "waters of the state" for mining, construction, and oil and gas activities must obtain a water rights permit from TCEQ. An applicant may apply for a Temporary Water Right permit for short-term use of "waters of the state." Your closest TCEQ Regional Office may issue temporary Water Rights permits authorizing use of 10 acre-feet or less and for one year or less. Applicants who seek to use more than 10 acre-feet of water or who seek a term of more than one year (up to a maximum of three years) will need to apply through the TCEQ Water Rights Permitting Team in Austin. TCEQ forms, fees, contacts and other information may be found at http://www.tnrcc.state.tx.us/permitting/waterperm/wrpa/permits.html#temporary

To discuss this authorization confidentially, you may contact TCEQ's Small Business and Local Government Assistance Austin office at 512/239-7015.

Draft Proposed Rules for Statewide Rules 95 and 97

The RRC has published draft rule proposals. These rule drafts are working drafts that have not been finalized and have not been submitted to the Texas Register for publication for public comment. The proposed rules relate to underground storage of liquid or liquefied hydrocarbons in salt formations. They can be found at http://www.rrc.state.tx.us/rules/draftproposed.html ■

Guest Editorial

The Debate Over Subsidence in Coastal Louisiana and Texas

by ***Arthur E. Berman***

Hurricane Katrina has devastated coastal areas of Louisiana, Mississippi and Alabama. In New Orleans, levees were breached and pumps failed. The city was flooded with up to 20 feet of water.

Poor policies by politicians and planners contributed to the city's vulnerability. Geologists and coastal scientists have been arguing for decades, unable to agree on the causes or rates of subsidence. Officials and the public understandably felt justified in making no decisions or temporary decisions because experts could not reach agreement. The scientific community must now accept some responsibility for choosing debate and inaction over collaboration and consensus for the public good in Louisiana.

Geologists are presently engaged in a great debate about the causes and rates of subsidence along the Texas and Louisiana Gulf Coast. In July, 2005, the National Oceanographic and Atmospheric Administration (NOAA) published *NOAA TECHNICAL REPORT NOS/NGS 50*, titled "Rates of vertical displacement at benchmarks in the Lower Mississippi Valley and the Northern Gulf Coast". Technical Report 50 concludes that rates of subsidence in southern Louisiana are significantly higher than previously thought. The report's authors, Kurt Shinkle, National Geodetic Survey, and Roy Dokka, Louisiana State University, estimate that southern Louisiana's rates of subsidence are between 200% and 5,000% greater than previous estimates, with the mean subsidence rate for southern Louisiana being 11 mm (0.43 inches) per year.

The scientific community must now accept some responsibility for choosing debate and inaction over collaboration and consensus for the public good

Scientists have differing opinions on the reasons for subsidence. Some believe that ground water withdrawal is the principal cause for subsidence. Others blame oil and gas extraction and many blame the reclamation and restoration efforts of the Army Corps of Engineers. Technical Report 50 suggests that none of these causes fully account for subsidence rates in southern Louisiana and that natural, geological processes must be considered.

Reaction To NOAA Technical Report NOS/NGS 50

Technical Report 50, released in July 2004, has ignited a debate of surprising intensity considering its conventional method of analysis and its geologically unremarkable inference that the Gulf of Mexico Basin is subsiding at rates greater than can be explained by human efforts to extract fluids from the subsurface. Mr. Dokka has been attacked both for the rates of subsidence cited in the report and for his belief that much of the subsidence is due to natural geological causes, including tectonic and depositional processes such as crustal down-warping, sediment loading, compaction, salt movement and gravity slumping, as well as eustatic sea-level rise.

Bob Morton, a geologist at the USGS Center for Coastal and Watershed Studies (CCWS), is Dokka's most vocal critic. Morton believes that most if not all of the subsidence and accompanying land loss in southern Louisiana is due to oil and gas production. "Terms like sediment loading and gravity sliding made perfect sense millions of years ago but they don't necessarily apply today," Morton says. "What Dokka doesn't tell you is that his data is recalculated from data that is at least ten years old. Maybe it applies today and for the next 100 years and maybe it doesn't. Withdrawing fluids from the subsurface produces the same results as sediment loading - but it's induced, not natural" .

Kristy Milliken, a graduate student at Rice University and her advisor, Dr. John Anderson, believe that Holocene subsidence rates in southern Louisiana are much lower than rates published in Technical Report 50. "It is difficult to reconcile those subsidence rates", said Anderson. Anderson said that the work he and his students have done along the Texas and Louisiana coasts indicate about 1 mm per year of subsidence based on radiocarbon marker dates

Jeff Williams, a USGS worker at the Woods Hole Oceanographic Institute, questioned the scientific credibility of interpretations in Technical Report 50. "This report, and the conclusions drawn from it need to be based on the best interpretations of the data available and I'm not confident that they are." Part of the problem, Williams says, is that the NGS raw elevation data were not published in the report and are not publicly available for peer review.

Technical Report 50

Subsidence is the downward displacement of the Earth's surface relative to a fixed datum. The datum used in Technical Report 50 is the North American Vertical Datum of 1988 (NAVD 88). The methods used in Report 50 involved a fundamental geodetic analysis.

The Debate Over Subsidence *continued on page 49*

Guest Editorial continued from page 47

Technical Report 50 integrated existing first-order leveling (surveying) data, Global Positioning System (GPS) observations and tide gauge information gathered by the National Geodetic Survey (NGS) over the past 70 years to re-calculate the elevations of more than 2700 benchmarks in southern Louisiana.

The resulting analysis indicates that subsidence has occurred during the past century and is probably still going on throughout the lower Mississippi Valley and adjoining coastal plain. Subsidence is greatest in coastal regions, especially in the Mississippi River delta plain where displacements of up to 30 mm/year were computed. Significant subsidence is occurring across much of southern Louisiana at a mean rate of 11 mm/year. The report concludes that a comprehensive program of height modernization is needed.

When asked about why Technical Report 50 has caused so much controversy, Dokka said, "Report 50 is fundamentally a geodetic report. It is not a strongly interpretive document and, in fact, only a very general background on the causes of subsidence is laid out. The geodetic method used in Report 50 is as good as it gets. "It is apparent from people's reaction that they see the implications of these rates (of subsidence). People see the numbers and that scares them. It will call into question a huge body of science that was thought to be settled for some time. An anomaly has been noted."

When questioned about lower subsidence rates cited by workers at Rice University, Dokka replied, "Why would you prefer methods that average events of the last several thousand years over fundamental geodetic observations made over the past few decades? "On the other hand," he added, "It depends on what kind of question you ask. If you want to understand how geological systems work, you have to look at more than the last few hundred years. You have to study the Earth at spatial and temporal scales appropriate to your question. If the question is, How is the Earth going to behave with respect to subsidence in the next 50 years in southern Louisiana?, then it is much more predictive to look at geodetic data rather than studying events of the past few thousand years."

Dave Zilkoski, Deputy Director of the NGS, said about the report "It is a sound report. No one disagrees with the heights (elevations). These are the best rates available." Referring to the use of existing leveling data, Zilkoski said, "If you had up-to-date data, you would have better information. The report represents the best science we can do without re-leveling."

Commenting on charges of "questionable science", Zilkoski said, "At the NGS we are geodesists. We can tell you about the vertical movement of monuments (benchmarks). We don't deal with the "why" of it. We leave that to geologists. I think (Bob) Morton is concerned with the interpretation of the rates. There is nothing

in Report 50 that discusses the causes of rates. I think it has been Roy (Dokka)'s discussion of geological causes beyond the report that some are objecting to."

He went on to clarify that Technical Report 50 is an official document of NOAA, NOS and NGS and is fully supported by those agencies. All data in the report is owned by NGS, is public, and results went through multiple peer reviews prior to publication. The part that Zilkoski says is open for discussion is the interpretation of the data and the cause of the subsidence rates.

Regarding Jeff Williams' comments to *Geotimes*, Zilkoski said, "What Williams is quoted as saying is incorrect. The data and results are publicly available. Most of it is on our (NOAA/NGS) Website. It is stated clearly that all you have to do to get more data is to request it."

Man-Made Causes of Subsidence

Most man-made subsidence results from ground water withdrawal, but the earliest observation of subsidence resulting from human activity was from oil and gas field production. The Houston, Texas area has perhaps the best examples in the world of subsidence that results from both ground water and petroleum withdrawal.

The first documented instance of land subsidence due to fluid withdrawal was from the Goose Creek Oil Field near the city of Houston. In 1917 oil was discovered on the margin of Galveston Bay near the mouth of the present-day Houston Ship Channel. After production of several million barrels of oil, bay waters began to inundate the oil field. Pratt and Johnson (1926) recognized newly formed faults and fissures that resulted from fluid withdrawal.

The Houston area has experienced the greatest and best-documented ground water-related subsidence in the United States. Because the relatively shallow Evangeline and Chicot aquifers are highly productive and predictable, most of Houston's early water needs were met by drilling water wells. As much as 6 feet of subsidence occurred in the vicinity of the Houston Ship Channel by the mid-1970s (Figure 3). By 1979, the Houston Ship Channel area had subsided as much as 10 feet and over 3200 square miles of the Houston metropolitan area had sunk an average of one foot. Most of Houston's subsidence is due to compaction of subsurface clays because of withdrawal of ground water from surrounding aquifer beds.

Subsidence Measurement in the Houston Area: The Harris-Galveston Subsidence District

Are coastal regions of Texas at heightened risk of flooding because of subsidence? Are all of Texas' subsidence issues the result of human activity or is there a geological component that should be considered?

The Harris-Galveston Subsidence District (HGSD) was established in 1975 to more accurately monitor and to "end subsidence" in the Houston metropolitan area. Due largely to the efforts of the HGSD, the Houston metropolitan area is converting from ground water to surface water use, principally from Lakes Houston, Livingston **The Debate Over Subsidence** *continued on page 51*

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and Conroe. Reductions in ground water pumping have resulted in impressive reduction or elimination of subsidence in many areas of Houston, though others remain problematic. For 2004, total groundwater withdrawal in the HGSD was 245 million gallons per day (5.8 million barrels of water per day) which accounted for 27% of total district water.

Ron Neighbors, General Manager of the HGSD, Tom Michel, Assistant General Manager and Cliff Middleton, NGS Geodetic Advisor to the Subsidence District at their office near Webster in the Clear Lake area were interviewed. Neighbors led off the discussion by saying that he is not happy with Dokka's claim that Houston has inadequate elevation control. "The HGSD knows more about heights than anyone else in the greater Houston area. Roy Dokka is creating an unnecessary political problem. He is talking about subsidence that is caused by factors other than ground water withdrawal. I don't doubt that natural geological compaction is a factor, but the Subsidence District is specifically charged with limiting subsidence due to ground water, and we have pretty much done that in many areas. There is still major subsidence in the North and West (north Harris and Fort Bend counties) where they are just beginning to meet the HGSD's requirements to convert from ground water to surface water."

"We're not into the cause (of subsidence). You geologists can have that part of it."

The most reliable way to update and calibrate the elevation values of benchmarks is to use surveying crews to carry a known elevation from a stable monument outside the region of recognized subsidence relative to the North American Vertical Datum of 1988 (NAVD 88).

"Re-levelings conducted as recently as 1987," Neighbors said, "cost at least a million dollars."

There are over 2500 benchmarks in the Houston metropolitan area, many of which were tied by surveying (or differential leveling) and later adjusted to the NAVD 88 datum. Leveling yields an orthometric height, essentially an elevation relative to sea level. Sea level is a dynamic value that is related by geodesists to the Geoid, an equipotential surface of the Earth's gravity field, which mathematically best fits global mean sea level. In a practical sense, this means tying the survey to a tide gauge. In the Texas Gulf Coast, tide gauges at Galveston Island or Corpus Christi are critical.

Because of the high cost of re-leveling, the United States Geological Survey and the Harris-Galveston Subsidence District have established a network of 13 mechanical subsidence measurement devices in Harris and Galveston counties called borehole extensometers designed to monitor subsidence without re-leveling.

Deeply anchored benchmarks are placed in what are believed to be stable strata in boreholes drilled to depths that range from 770 to 3072 feet below the surface. The borehole is lined with flexible casing that can adjust to compacting strata. An inner pipe is anchored to a concrete plug at the bottom of the borehole and connected to a recording device at the surface. The extensometer provides a continuous measurement of the difference between the elevation of the cement plug at the bottom of the borehole and the land surface surrounding the borehole. Though less expensive than re-leveling, the cost of drilling and maintaining borehole extensometers - about $800,000 per unit - limits their use and distribution in the Houston area.

Mike Turco, Houston Office Chief, USGS Texas Water Science Center, directs the efforts to understand ground water-related subsidence in the Houston area. "We have 30 years of extensometer data that gives monthly rates of clay compaction around the Gulf Coast aquifers," Turco said.

The limited distribution of borehole extensometer devices is in part remedied by use of the Global Positioning System (GPS) of satellites to measure and reference subsidence to certain extensometer sites. Three anchored benchmarks record both extensometer measurements as well as GPS elevation data. These locations are referred to as Continuously Operating Reference Stations (CORS).

GPS measures the 3-dimensional position of a point relative to the center of the earth. This position is then referenced to the ellipsoid, a mathematical best-fit model of the Earth's surface, which allows a vertical component to be isolated, known as an ellipsoid height. Here lies the problem in obtaining millimeter-scale elevations with GPS: there are many models for calculating an ellipsoid and topographic elevations above or below a hypothetical ellipsoid are very small compared with the distance to the Earth's center. Once an ellipsoidal height is determined, it must be further calculated relative to sea-level (NAVD 88) in order to be reconciled with orthometric leveling data.

When Dave Zilkoski was asked about the vertical resolution of GPS, "To get sub-centimeter vertical resolution," he said, "you must occupy a GPS station for a long time. A 24 hour solution only gives about 1–2 centimeter vertical resolution. For now, the resolution is not as good as leveling but, at least in Louisiana where subsidence rates are high, it provides a framework." Zilkoski added, **The Debate Over Subsidence** continued on page 52

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"A single 24 hour solution does not give the millimeter per year resolution we need. The HGSD PAMs can provide more accurate solutions because they occupy each GPS station for a week at a time."

PAMs (Port-A-Measures) are trailer-mounted GPS devices that rotate among various reference stations at one week intervals including CORS stations.

The Geological Component of Subsidence

The Harris-Galveston Subsidence District and the National Geodetic Survey have established a network of approximately 28 subsidence monitoring stations from which reasonably reliable elevations and vertical displacements can be obtained. Extensometer stations provide an approximation of compaction due to groundwater withdrawal, while CORS GPS and PAM stations provide an approximation of total subsidence. Unfortunately, only the CORS GPS stations provide both data in the same location. Compaction-related subsidence at Addicks averages 0.11 ft/year (3.4 cm/year). Total subsidence data for the CORS GPS and PAM sites are shown in Figure 17, a map made in 2001. Addicks is shown to be subsiding at 4.0 cm/year.

Publicly available data from Houston's network of GPS and extensometer sites, only permit direct comparison at the Addicks location. Addicks data, by my analysis, suggests that 6 mm/year or 15% of total subsidence may be related to normal basin subsidence.

Estimates of movement by Shah and Lanning-Rush and on the Long Point Fault yield rates approximately equal to and up to 3.5 times greater than Addicks. These subsidence rates are consistent with ranges reported in Technical Report 50 for Louisiana.

In 2004, the U.S. Geological Survey (USGS), in cooperation with the Harris-Galveston Subsidence District, interpreted newly acquired LiDAR (Light Detection and Ranging) data and updated the locations of principal faults. Fault interpretations have not been incorporated into publicly available maps of subsidence or water level changes in Texas aquifers by the HGSD.

Mike Turco of the USGS commented, "It has never been the position of the USGS that fluid withdrawal is the only cause of subsidence. There is a structural component to subsidence. Petroleum-induced subsidence should be very localized. Our charge, however, is to understand compaction at and around the extensometers."

Toward an Assessment of Elevation Control in the Texas Coastal Region

Gilbert Mitchell, NGS Manager of Geodetic Programs, coordinates the NOAA/NGS state technical advisor program, including Texas, and is NOAA's height modernization grants manager "We have sufficient information that we're comfortable with heights, but Texas needs better, more accurate heights," he said. "GPS is not quite the answer-yet."

"The HGSD only monitors part of subsidence," Mitchell said. "Coverage is limited and much data has not been published." When asked if the current CORS and PAM sites were sufficient, he replied "It's not a pretty scene. It's not good enough in our eyes for subsidence and floodplain mapping especially if want to know if you need flood insurance or not. We're on the edge of 2-3 cm of accuracy. Obviously, improvements can be made."

Asked about geological causes for subsidence, Mitchell said, "We're not into the cause. You geologists can have that part of it. It's not our thing. We're worried about heights, whatever causes them. We just measure them."

Oil and Gas Production As a Factor in Gulf Coast Subsidence

Bob Morton of the USGS is one of the chief critics of Technical Report 50. Morton declined to be interviewed, replying that everything he has to say about subsidence in the Gulf of Mexico could be found in Open-File Report 2005-1216 (OFR 2005-1216).

OFR 2005-1216 examines five areas located in distal portions of the Mississippi River Delta that have experienced considerable land loss from subsidence over the past 40 years. The report initially states "… the rapid subsidence and associated wetland loss were largely induced by extraction of hydrocarbons and associated formation water with some subsidence controlled locally by sulfur mining at a few sites". In the body of the report, however, the authors admit that at only one of the locations studied can subsidence be possibly related to oil and gas production. No substantiation is presented other than geographic coincidence of land loss and petroleum production.

The Path Forward

Thomas Kuhn explains in *The Structure of Scientific Revolutions* that science is a pursuit that is seldom directed toward discovery of anomalies and in fact tends at first to suppress them. "Scientific research", he wrote, is "a strenuous and devoted attempt to force nature into the conceptual boxes supplied by professional education".

Technical Report 50 has revealed and documented an anomaly, namely, that subsidence rates in southern Louisiana are higher than previously believed and that a certain component of that subsidence may be due to normal geological factors. Some in the scientific community have denied or discounted the anomaly by disparaging the report, its methods and its authors. This is predictable according to Kuhn. It does not however diminish the anomaly.

In Texas, many workers say that a similar investigation is unnecessary because

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Houston has the most advanced technology for monitoring subsidence anywhere in the world.

It is time to return to underlying causes and to abandon defense of previous efforts and explanations. In Texas, it is time to move beyond the accomplishments of ground water subsidence mitigation and the application of technology to subsidence monitoring. It is time to recognize that there is more to the story than ground water.

It is time for all of the agencies involved to take collective responsibility for total subsidence. It is the author's belief that this should be a federal responsibility and that perhaps the Department of the Interior should mandate attention to total subsidence and demand collaboration among agencies.

The Gulf of Mexico basin is subsiding. That's what basins do. This basin was subsiding long before man appeared on the planet. Let's get past acceptance of what is geologically undeniable. Let's work together to find the resources for the first order leveling and expanded GPS network that is needed so we can plan for the future. ■

Selected References

Douglas, B. C., 1997. Global sea rise; a redetermination. Surveys in Geophysics, 18: 279-292.

Morton, R. A., 2003 An Overview Of Coastal Land Loss: With Emphasis On The Southeastern United States, USGS Open File Report 03-337, 29 p.

Pratt W. E., and Johnson, D. W., 1926, Local subsidence of the Goose Creek Oil Field: Journal of Geology, v. 34, p. 577-590.

EDITOR'S NOTE:

This is a condensed version of Mr. Berman's original submission for the Bulletin. *The article, along with figures and references, will be available on the HGS Website.*

*The HGS/ECH sponsored symposium "*Coastal Subsidence, Sea Level and the Future of the Gulf Coast*" on November 3 and 4 (see page 24 of this issue) covers this important topic in detail. Everyone is encouraged to attend.*

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HGA *and* GeoWives **News**

HGA

by Edie Bishop, HGA/HGS Liaison

Fall has been a very productive time for the Auxiliary, from the opportunities to serve our primary role of assisting the Society to the occasions of enjoying time with members.

In early August, the HGS Technofest again proved to be a great success. The cost of admission was so low ($5) that through the scrumptious buffet and complimentary drink tickets attendees were ahead a few coins! The geological community always enjoys a good deal. Thanks to Mike Allison for inviting us to assist with registration. Special thanks go to Society and Auxiliary members Anne Boutte, Vicki Pickering, Norma Jones, George Bole and Dick Bishop (with a little spousal arm twisting!)

After 13 years, the ever-successful NAPE expanded to include a Summer NAPE and, for the first time, partnered with the AAPG Prospect and Property Expo (APPEX) to host the event. With oil prices above $60, the George R Brown Convention Center was the place to be on August 24 and 25. A special thanks to Hellen Hutchison for including us in the volunteer effort. Society and Auxiliary members who braved the early morning hours and did an excellent job were Tina and Kate Hoffman, Paige Moore, Mary Harle, Betty Alfred, Janet Steinmetz, Helen and John Thomas, Elinor Macmillan, Mikki Wunderle, Winona LeBrandt Smith, Rosann Hooks, Sally Blackhall, Dene Grove, Millie Tonn, Vicki Pickering, Anne Rogers, Shirley Gordon, Norma Jean Bacho, Daisy Wood, Myrtis Trowbridge, Pat Burkman, Jennifer Biancardi, Sara Nan and Jim Grubb, and Norma Jean Jones.

Turning to the social side, on September 13 Chairperson Marti Lund and her committee were marvelous hosts at our first luncheon of the year at Maggiano's Little Italy where guest speaker Jan Hargrave, author of "Let Me See Your Body Talk" discussed reading people through non-verbal communication. Jan is a distinguished speaker for both entertainment television and corporate America. Her wit, contagious warmth and excellent presentation charmed everyone, plus gave an additional ability to understand our fellow man a little better. Spouses, beware!

For upcoming events, you don't want to miss GeoWives for the St. Luke United Methodist Church's Holly Hall Book Review of "Books on the Frontier" by Richard Clements on October 26 at 10:30 a.m. A discussion on frontier favorites will be led by Rose Mary Rumbley from Dallas. Lunch at Andres will follow the review. Call Sara Nan Grubb at 713-278-9369 for more information and reservations. ■

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The guidebook will include papers on various aspects of resource evaluation, exploration, petrophysics, reservoir potential, well deliverability, and drilling and completion technology. As new shale plays are explored for and developed, it is important to learn from analogs and case histories, including those from outside the Rocky Mountain region. While the emphasis is on natural gas, we realize there is also value in learning from our experiences from shales and other fine-grained source rocks that have produced oil from Rocky Mountain basins. RMAG encourages submissions of case histories and analogs that are important to Rocky Mountain gas shales. The guidebook will be published as a CD and therefore can accommodate large data sets, maps and color illustrations.

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