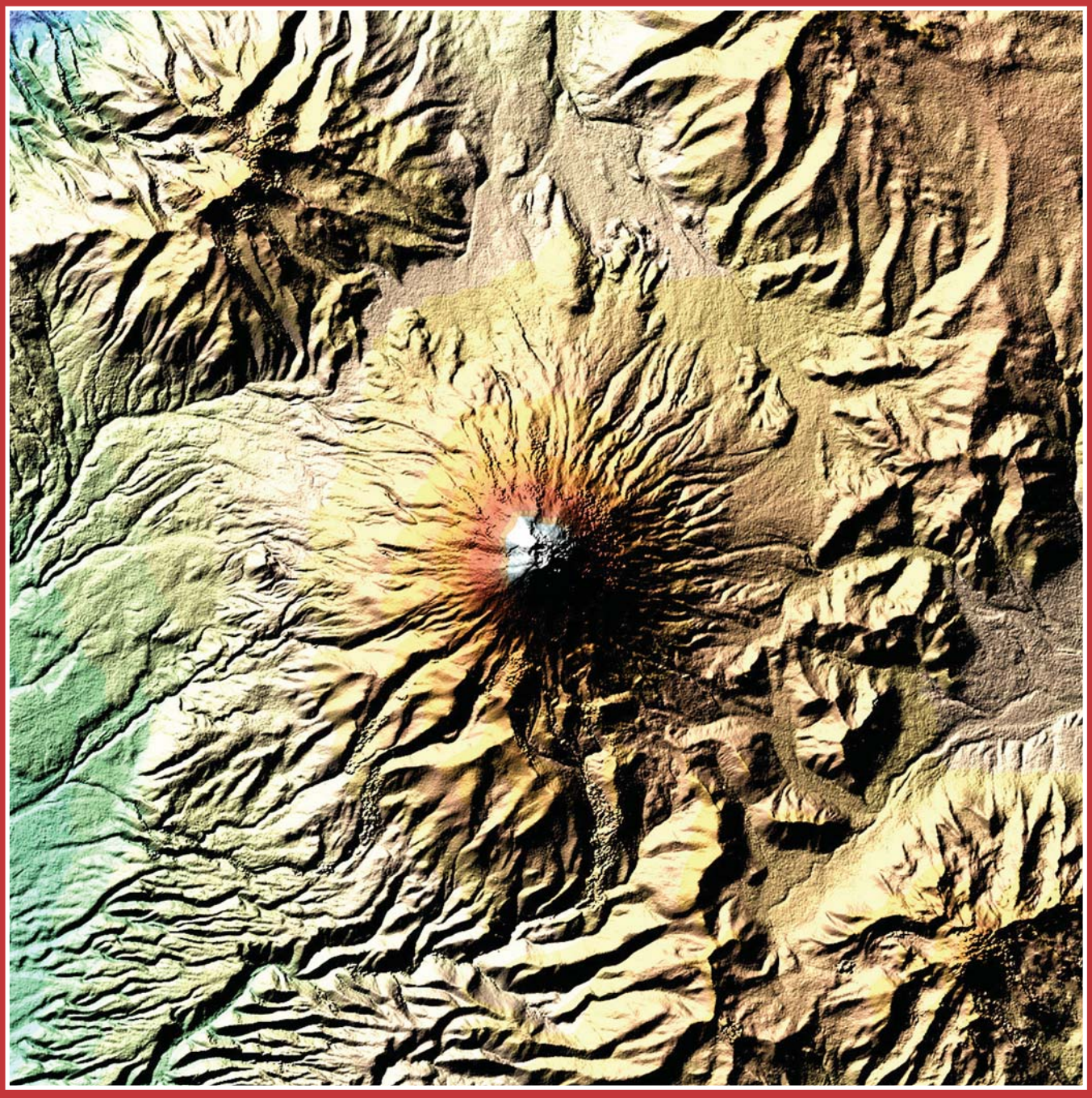
HGS Bulletin
Houston Geological Society
Volume 48 Number 4
December 2005

A Compressional Origin for Minibasins Near the Sigsbee Scarp, Gulf of Mexico *Page 23*



The Bulletin
Houston Geological Society

Volume 48, Number 4 December 2005

In Every Issue

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Technical Meetings

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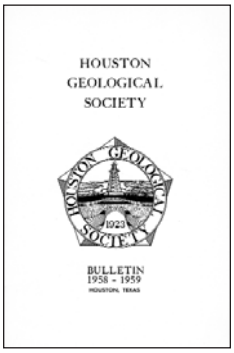

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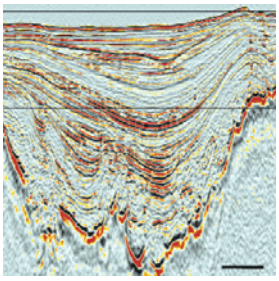

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About the cover: On February 19, 2000, Space Shuttle Endeavour passed over the highly active and dangerous volcanic zone of the Andes in Ecuador. Endeavour mapped elevations on most of the Earth's land surface during the Shuttle Radar Topography Mission (SRTM). There have been more than 50 eruptions of Mt. Cotopaxi alone since 1738.

The digital elevation model acquired by SRTM, with its resolution of 25 m x 25 m, is so rich in detail that you can even make out an inner crater with a diameter of 120 m by 250 m inside the outer crater (800 m x 650 m). Blue and green correspond to the lowest elevations in the image, while beige, orange, red, and white represent increasing elevations. *Text and Image Courtesy of NASA Earth Observatory*

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From the **President**

by ***Dave Rensink***

Lost in the Jargon

I was able to play a small part in the opening ceremonies for Earth Science Week at the Houston Museum of Natural Science in early October. Martha McRae, Jennifer Burton and their Earth Science Week Committee members are to be commended for putting together a hands-on program that informed and entertained 400+ kids on a Saturday afternoon. Suffice it to say the energy level in the museum was high. Martha compared the process to herding cats, but I think it may be more akin to herding cats high on catnip through a room full of rocking chairs. I spent a little time listening to the discussions at some of the learning stations, and the volunteers did an excellent job in describing the fossils, minerals and geologic processes in a manner the kids could understand. Some of the kids looked at the event as more of a race than a learning experience, but the purpose of Earth Science Week is to spark an interest in geology. For some of these kids, it may be the only exposure they ever get. Our thanks also go to the Houston Gem and Mineral Society, the National Association of Black Geologists and Geophysicists and the Association for Women Geoscientists for their participation.

One of the four facets of our mission statement is "to aid and encourage academic training in the geosciences." We accomplish this through the Earth Science Week Committee, Academic Liaison Committee, Museum of Natural Science Committee, and two foundations that provide scholarships to undergraduate and graduate students in geology. It is also reflected in our short courses and the technical talks at our lunch and dinner meetings. Education is a major focus for the HGS. It is a large part of who we are and what we do.

As geologists, it is almost inconceivable to most of us that others would not be interested in the origin of earthquakes, volcanoes, tsunamis, seafloor spreading or any other earth processes. Geologists are cool because we can walk up to a road cut, bang on the rocks with purpose, and talk with an air of authority on the mineral composition of igneous and metamorphic rocks or the depositional environment of sedimentary rocks. Well, we are cool for about 15 minutes; after that, some of us tend to lose non-geologists in the jargon.

When my daughters were young, they thought it was interesting, or at least amusing, that I carried a rock hammer in the trunk of the car and periodically stopped at road cuts for at least a cursory look. As they grew older, these stops were most often met with chagrin and they generated more than a little ridicule. The turning point between my being amusingly eccentric and embarrassingly obtuse may have occurred at a road cut near Canyon Lake in the Hill Country. One of my daughters picked up a rock and asked what it was. Without giving it much thought, I said it was a pelecypod. Her response was, "Really? It looks like a clam," I'd lost her in the jargon.

The use of technical terms is an efficient way for us to communicate with each other, but the message gets lost when we use them on the public. Obviously, geologists who routinely give talks to the general public know this. But if someone at a class reunion asks you what a geologist does, how long does it take before you see their eyes glaze over? My hat is off to you who instinctively know your audience and are able to tell them what they want to know and not what you think they need to know.

Geologists are cool because we can walk up to a road cut, bang on the rocks with purpose, and talk with an air of authority

Are the HGS programs successful in attracting students to geology schools? Who knows? There is no direct way to measure it. However, whether or not we have had a significant impact, there is definitely good news in the halls of higher education. According to a survey conducted by the American Geological Institute and reported in the October issue of the *AAPG Explorer* by Barry Friedman, the number of geology students in US colleges and universities has increased 5% per year over the last three years.

It would be interesting to know what percentage of these students started their college career as geology majors as opposed to those who transferred into geology from other disciplines. It has been my belief (supported by informal polls of my fellow diners at HGS meetings) most of us started our college careers in another discipline, often engineering or another science. I started in aeronautical engineering, and I took geology as a science elective. Even though I grew up on a dairy farm and thought I knew something about dirt and rocks, GEOL 1 was my first exposure to geology. I am not sure my high **From the President** *continued on page 9*

HGS *Bulletin* Instructions to Authors

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

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

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

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

Advertising

The *Bulletin* is printed digitally using QuarkXPress. We no longer use negatives or camera-ready advertising material. Call the HGS office for availability of ad space and for digital guidelines and necessary forms or email to ads@hgs.org. Advertising is accepted on a space-available basis. **Deadline for submitting material is 6 weeks prior to the first of the month in which the ad appears.**

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We also offer a Banner ad across the top of our monthly Newsletters sent to registered users of the Website. Job postings are available for $50 for 30 days on the Website but they must be geoscience jobs of interest to our members. Current HGS members may post their resumes at no charge. If you have a product or service available at no charge, you can post it in the Business Directory at no charge. Geo-related Business Cards and job openings may be posted directly by any registered user and members may post their own resumes. They will be activated as soon as practical.

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From the **Editor**

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

The Changing Face of the *Bulletin*

TOP TEN REASONS YOU MIGHT BE A GEOLOGIST: *
7. You have taken a 15-passenger van over "roads" that are intended only for cattle.
next month, reason no. 6…

The first *Bulletin* of the Houston Geological Society was volume 1, number 1, published in September 1958. It was 20 pages, 5½ by 8½ inches in size, printed in black and white with no pictures, and had meeting announcements, committee reports and new member lists. The cover bore the HGS logo designed in 1949, the words "Houston Geological Society" and "Bulletin 1958–1959 Houston, Texas" (figure 1). It was your basic newsletter. The style persisted until 1973 (figure 2) when the meeting announcements were printed on the cover, which consisted of colored, heavier-stock paper. The November issue, volume 16, number 3, showed George Mitchell presenting the talk "The Nation's Need for the Independent Explorationist" at the dinner meeting and Don Bebout presenting a talk on the Stuart City Trend. The HGS Shrimp Peel was held that month and cost $4.50 in advance, $5.50 at the door. Still largely a newsletter, it included the Professional Directory that still appears in the *Bulletin* today.

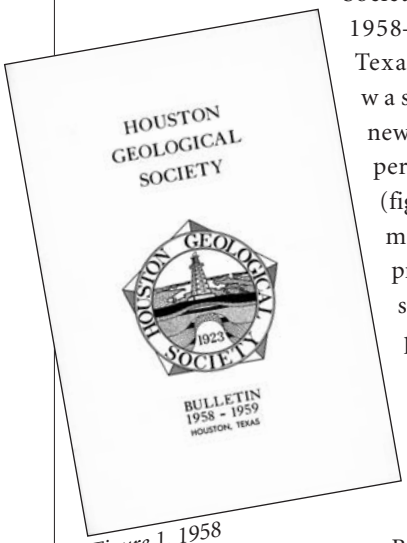

Figure 1. 1958

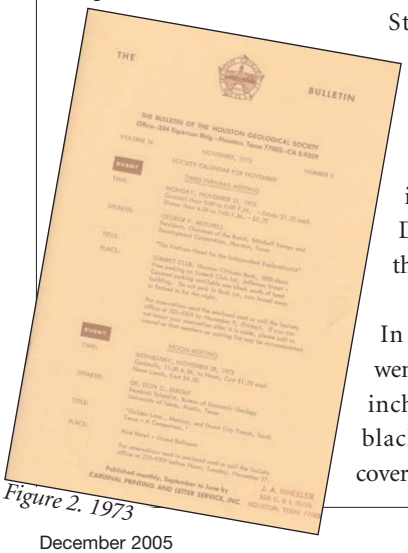

Figure 2. 1973

In 1975, the September issue went to a larger format, 8½ by 11 inches in size (figure 3), with a black-and-white photo on the cover, but still bearing the meeting announcements under the photo. Still largely consisting of the two monthly meeting abstracts, it ran about 16 pages (20 pages in all with the cover pages) and began including paid advertising other than the Professional Directory section. The cover was a beige heavy-stock, an appearance that continued until September 1988. By then, the *Bulletin* was running about 52 pages in size, limited by the binding equipment that the printer had. Articles began appearing other than the meeting abstracts and committee news. A section called the "Digital Digest" appealed to an increasing interest in computers, and an article on developing maps for the future was featured in the June issue that year. A column on exploration activity was also present that year. The *Bulletin* began taking on a full-scale periodical appearance.

Bulletin content comes from the HGS membership, so it is truly an interactive publication

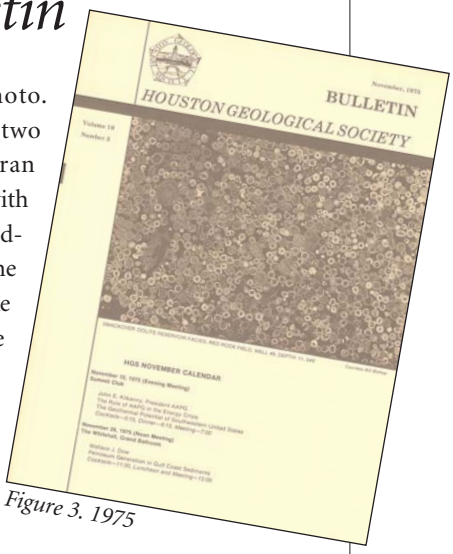

Figure 3. 1975

In September 1988, the *Bulletin* evolved further with a white glossy cover that would better accommodate photos, though the overall design remained the same. By June 1993, the *Bulletin* was running 72 pages in length. Extended meeting abstracts presented mini-papers with numerous figures, and a one-page center-fold calendar appeared, featuring the HGS events for that month. The *Bulletin* also became a two-color publication that year, with the cover and selected pages having a second color along with black, which made the cover and ads more appealing. The first color photo on the cover appeared in the March 1995 issue, showing a ruptured pipeline

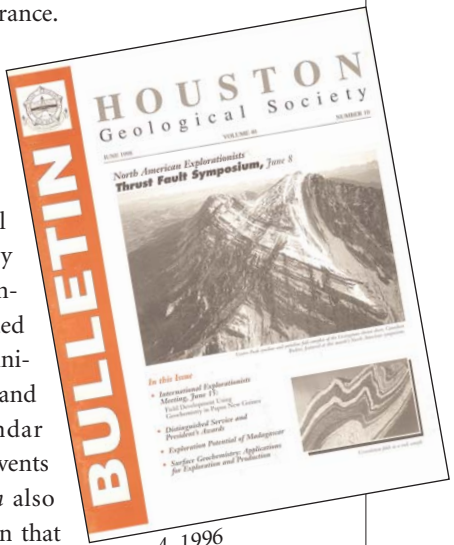

Figure 4. 1996

From the Editor *continued on page 9*

From the President

continued from page 5

school library even possessed a geology text. By the end of GEOL 1, geology looked like a lot more fun than watching smoke pass over an airfoil or doing statics and dynamics calculations. It was particularly comforting to learn that you can make money in geology, at least most of the time. That is the message we want to get across to the kids—geology is interesting, fun, and potentially profitable. It is inconceivable to me that the "best and the brightest" would want to do anything else.

With Christmas vacations coming up for many of our members, December is a light month for technical talks. Our regular dinner meeting is being held in conjunction with the North American Explorationists this month on the 12th. Do not despair; we have a full calendar in January. Do not forget to make your reservations. ■

Merry Christmas and Happy New Year

From the Editor

continued from page 7

Figure 5. 2005

burning in the San Jacinto River flood. September 1996, saw a fundamental design change in the cover, with the name "*Bulletin*" appearing along the left-hand side and running vertically (figure 4). In 1998, the center-fold calendar became a two-page spread, a design that persists to the current issue.

The *Bulletin* took on its current design in September 1998, under Craig Dingler's editorship. The name "*Bulletin*" was moved to the top of the page, and a full-color photo graced the cover (figure 5). This design is in current use, and each year, the incoming editor gets to select the masthead color for that year. The *Bulletin* is now published electronically in full color on the HGS Website as in PDF format and is printed with some of the pages changed to black and white or two color to save cost. The annual production cost runs about $125,000 to $140,000, depending on the number of pages that year. Advertising income helps defray that cost, or even covers the cost, depending on the year. There is far more history to the *Bulletin* than a short article will allow, and each editor has made improvements, large and small. The *Bulletin* has won graphic design awards in the past and is recognized as one of the best local society publications in the world. Your current editor is proud to carry on the Society's tradition in providing a good-quality publication, but most of the content comes from the membership, so it is truly an interactive publication for the members. ■

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). ■

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Letters to the Editor

To the Editor:

Comparing Apples and Oranges

Arthur Berman's editorial in the October 2005 *Bulletin* is very informative and should help focus investigators' research on subsidence in Houston, the Mississippi Delta and surrounding areas of the Gulf Coast. I'd like to make one observation based on Berman's summary of findings by the various published investigators and government agencies. Nowhere in the various quoted comments is it acknowledged that Houston's geologic setting is very different from that of the lower Mississippi Delta. Groundwater and hydrocarbon withdrawal having caused significant subsidence in the Houston area does not mean that they are the dominant factors in the delta. Likewise, crustal downwarping as a result of the tremendous sediment column associated with the Mississippi should not be assumed to be the major culprit in Houston. The various interested parties would do well to put aside their preconceived ideas and work together to understand this serious issue and its various causes on a regional basis.

William Meaney
Anderson Oil & Gas, Inc.
Shreveport, LA

Author's reply:
Mr. Meaney is correct that the article did not specifically address geological differences between Texas and Louisiana coastal regions. The experts quoted [in the article] did not address the distinctions that Mr. Meaney notes between the geology of Texas and Louisiana, perhaps because this is not central in their view to what really needs to be understood and resolved with respect to subsidence.

It is important to note that the article published in the October *Bulletin* was significantly abridged and did not include approximately 20 figures that might have clarified some of Meaney's concerns. I suggest he review the Web version when it is available to decide if his issues were or were not in fact covered.

What I addressed in my October *Bulletin* article and what Mr. Meaney is responding to is chiefly the geological component of subsidence as a factor distinct or in addition to the man-made causes of subsidence. Technical Report 50 revealed that when benchmark velocities were systematically calibrated and measured in Louisiana, new insights on total subsidence were gained. Until a similar method and approach is applied to Texas, it is largely speculative what subsidence differences may exist between Louisiana and Texas. It seems reasonable that much would be learned and gained from such a geodetic analysis in Texas.

The Houston-Galveston Subsidence District has shown that very high rates of subsidence have occurred in the Houston area. While the Subsidence District's data indicate that these rates have declined or ceased in some areas, other parts of the Houston metropolitan area continue to subside in a manner and pattern that is difficult to explain. This means that there is still much that is not understood about subsidence in an area that probably has the most data and sophisticated measurement technologies of anywhere in the United States.

The public deserves to know what the scientific community has to say about subsidence and its effect on their lives and property. Government needs to understand liability issues for flooding related to subsidence. Scientific experts and administrative agencies need to get beyond what must seem to the general public like meaningless differences and distinctions. Scientists and agencies such as the United States Geological Survey, the National Geodetic Survey and the Houston-Galveston Subsidence District must tell the public what information is needed and what it will cost in order to provide answers to their questions and concerns. I suggest that conducting a measurement study in Texas using the same approach that Technical Report 50 provided for Louisiana is a logical and necessary first step in this process.

Respectfully,
Arthur E. Berman

EDITOR'S NOTE: *The original submission of this article was 15 pages of text and references, along with 20 figures, and so was indeed greatly shortened for print as Mr. Berman states. A more complete version of the article with selected figures can be found at www.hgs.org*

Member News and Announcements

Art Berman is the new HGS Website Committee Chair, replacing long-time chair Bill Osten.

Vacanies exist for the JUNE 16-24, 2006 **HGS Grand Canyon Geology Field Trip** rafting on the Colorado River in the Grand Canyon. Meet and return to Las Vegas, NV. Cost estimated to be $2200 apiece (includes food & drinks while in canyon, lodging June 16, guide tips, guidebooks). Contact Dave Lazor at jdlazoroilngas@aol.com for more information.

Geo-Legends 2006

Monday, January 9, 2006

Special HGS Dinner Meeting Program

A memorable evening featuring:

Albert Bally

Arnold Bouma

Peter Rose

Peter Vail

Join us for a memorable evening to include a social hour and elegant dinner at the Westchase Hilton Hotel. Our invited Geo-Legend panelists will tell their own life stories, followed by a panel discussion and audience participation.

Westchase Hilton, 9999 Westheimer (east of Beltway 8)
Social hour starts at 5:30 pm
This special HGS Dinner Meeting has limited seating.
Please make your reservations online at www.hgs.org ,
or by mailing in this reservation form with payment before noon Friday, January 6.

Registration Form — Geo-Legends 2006

Reservations and prepayment encouraged by online reservation or mailing checks to:
Houston Geological Society, 10575 Katy Freeway Suite 290, Houston Texas 77024

Name: _____

Company: _____

Work Phone: _____ Email: _____

No. of tickets desired: _____ Pre-registered Members & Spouses $25_____ Walk-ups/Non-members $30_____

Total amount enclosed:_____ Membership No. _____

(Please include names of all attendees, for registration badges): _____

_____

Geo-Legends 2006, January 9, will Feature Life Stories from Four Much Admired Geologists

*by **Linda Sternbach,** HGS Vice President*

The HGS dinner meeting on Monday, January 9, 2006, will be a special panel discussion featuring four great names in geology: Albert Bally, Arnold Bouma, Peter Rose (current AAPG president) and Peter Vail, who will be presenting their perspectives on the past, present and future applications of geology and oil exploration. The event will include a social hour, elegant dinner and a two-hour talk program to be held at the Westchase Hilton hotel, 9999 Westheimer, in west Houston.

It has become a great HGS tradition to host a "Legends" panel discussion dinner every few years. The first "Legends in Wildcatting" program in 2001 featured prominent oil legends Marlan Downey, Joe Foster, George Mitchell, John Seitz and Gene Van Dyke and was moderated by Jim Funk. The second program, called "Legends in Wildcatting, 2003," featured Michel Halbouty, Bill Barrett, Thomas Barrow, Marvin Davis and Robbie Gries and was moderated by Charles Sternbach.

It's time for the Legends theme to recognize that behind great oil businessmen are great geologists who have created the scientific technical work that ultimately results in discovery of oil and gas. Our four invited panelists are well-known names, both for their careers of teaching and their experience in practical hydrocarbon exploration. What they all have in common is that all four Geo-Legends worked for major oil companies during the 1960s and 1970s, and then changed careers to be outspoken teachers and communicators. However, each panelist has an individual point of view on geology and geophysics as professions, based on their unique careers. The HGS dinner program on Monday, January 9, will include a presentation from each panelist, and then a group discussion on how geologists work today and what can happen to our profession in the future. The audience will have a forum to ask questions to the panelists. HGS plans to create a video record of the event.

HGS members can sign up for the Geo-Legends program using the HGS webpage at www.hgs.org. We expect this event to be highly attended and are making space for 250 people. We suggest that HGS members and their guests pre-register before Friday, January 6. The cost is $25 for HGS members and $30 for non-members. ■

HGS Welcomes New Members

Effective September 1, 2005

JOHN WELCH
TONY PERRY
RUBEN PASCUAL
EARL OLSTED
ROSEMARY LAIDACKER
GAIL KETTENBRINK
TONY JOLLY
SHARON COURTNEY
CHARLES BERG
TERRY AXTMANN
JAMES CEARLEY
WILLIAM AMBROSE
JAMES KWASNY
RACHEL JOHNSON
MANETTA DILLINGHAM
STEVEN GUSTISON
KYLE JOHNS
ALEXEI MILKOV
TOM KNODE
RICARDO BRANDA
NICHOLAS DELEBO
FREDDY YIP
ERIC SWANSON
STEPHEN NEWTON
APRIL WILKE
DOMINIC DRUKE

ASSOCIATE MEMBERS

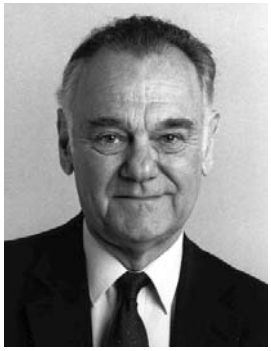
SHIRLEY STARLING
GAIL BRYAN

STUDENT MEMBERS

CLAY BROLLIER

Welcome New Members

Geo-Legends 2006



Albert W. Bally
Geo-Legend: Seismic Interpretation of Complex Structure

Arnold Bouma
Geo-Legend: Deepwater Sands and Depositional Processes

Bally has dedicated his career to the complicated task of geophysical interpretation and analysis of complex subsurface structures. He realized that seismic reflection data was key to unraveling highly deformed rocks. His research on fold-thrust belts, basin analysis and the concept of "orogenic float" is classic work. Bally is a pioneer in "thin-skinned tectonics"—originally from research in the Canadian Rocky Mountain fold and thrust belt. His work has provided excellent guidance to geologists drilling for oil in deformed tectonic provinces.

Albert Bally was born in The Hague, Netherlands, in 1925. He became interested in geology as a boy exploring the volcanoes and foothills around Rome and spent his early years in Indonesia, Switzerland and Italy. He received a PhD degree in geology from the University of Zurich in 1953, completing a study of an area in the Central Alpennines, Italy, in his thesis. Bally did post-graduate research at the Lamont-Doherty Geological Observatory of Columbia University, New York before finding his way into the oil business.

In 1954, Bally was offered a position with Shell Oil Company. He began with Shell Canada in Alberta, where he explored for prospects in the Rocky Mountain overthrust belt. Exploration programs at Shell during that period included the Rocky Mountains and foothills of Alberta, British Columbia, the Northwest Territories and northern Yukon. From 1962 to 1966, as chief geologist, he was concerned with all Canadian exploration matters. In 1966, Bally was transferred to Houston as manager of geological research at Shell Development, Houston. He was appointed chief **Geo-Legend Albert W. Bally** *continued on page 19*

Sedimentology classes all over the world learn the 1962 groundbreaking work of Arnold Bouma when they learn about the Bouma sequence. The Bouma sequence divides deepwater turbidite deposits into A-D intervals, based upon grain size and sedimentary structures and as a reflection of proximity to channels in submarine fans. As the oil exploration industry initiated drilling in deepwater provinces, Bouma's research on reservoir turbidites became crucial to better well locations and reservoir prediction. As a master teacher and researcher, Bouma has documented transportation and deposition processes responsible for deepwater sand deposits and revealed their influencing factors. These factors include tectonics, climate and sea level fluctuation. His classic studies include the Delaware Basin in West Texas, Jackfork Group in Arkansas, Annot-Peria Cava area in France and Permian Tanqua Karoo formation in South Africa.

Arnold Bouma was born in 1932 in Gröningen, Netherlands. His education was at the State University at Utrecht, Netherlands, where he studied under Professor Ph. H. Kuenen in undergraduate classes. He earned an MS in geology, sedimentology and paleontology in 1959 and a PhD in sedimentary geology in 1961 under Professor D.J. Doeglas. His first contact with turbidites was assisting his professors' research using European outcrops and flume studies. Arnold Bouma married Mechilina Kampers in 1961; they have three children.

Bouma received an invitation from Professor Francis P. Shepard to come to the Scripps Institute of Oceanography, La Jolla, California, in **Geo-Legend Arnold Bouma** *continued on page 19*

Peter Rose
Geo-Legend: Prospect and Risk Analysis

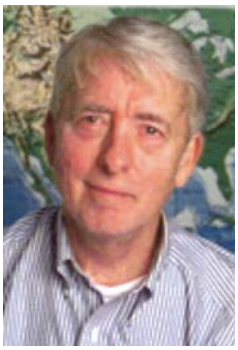
Peter Rose has taught the oil and gas industry a formalized risk analysis procedure as a recipe that can maximize exploration success by analyzing potential gain, potential loss, chance of success and money exposure of a portfolio of prospects. His career goal has been to help geologists make money during the oil-finding process, by teaching the working geologist how to assess project risk vs. reward.

Pete Rose was born in 1935 in Austin, Texas. He earned three degrees in geology from the University of Texas at Austin: BS (1957), MS (1959) and PhD (1968). Before he returned to UT for his PhD, Rose worked for 9 years at Shell Oil in Houston, Corpus Christi and New Orleans as an exploration geologist. After getting his PhD, he taught for a year at SUNY, Stony Brook, New York, but then returned to Shell Oil for 4 more years from 1969 to 1973 as a staff geologist in Denver and Midland.

In 1973, Rose joined the USGS in Denver as Chief of the Branch of Oil and Gas Resources. During his tenure the USGS established its first continuously-functioning petroleum resource assessment group, a function that has expanded greatly since 1975. In 1976, Rose joined Houston-based Energy Reserves Group Inc. (now part of BHP Petroleum) as chief geologist and director of frontier exploration. He wrote numerous technical articles on carbonate sedimentation and regional stratigraphy of the Gulf Coast, Mid-Continent and Rocky Mountain regions. Throughout his career, Rose has explored for oil and gas in most North American geological provinces and has published and lectured widely on U.S. resource assessment, basin analysis, play development, prospect evaluation, and risk and uncertainty in exploration.

In 1980, Rose established his own independent oil and gas consulting firm, Telegraph Exploration, Inc. In 2000, he founded and became managing partner of Rose and Associates and since then has been deeply

Geo-Legend Peter Rose *continued on page 21*



Peter R. Vail
Geo-Legend: Sequence Stratigraphy

Before Peter Vail's work, geologists used well logs and biostratigraphy to correlate rocks and geophysicists used seismic interpretation, but the two disciplines didn't work together in exploration. It seemed inconceivable that well log correlations and seismic interpretation could fit into a larger picture. Vail determined, while working at Exxon's research lab, that seismic reflections follow the detailed bedding patterns on the real physical surfaces in the rocks. It marked the discovery of the major underlying principle of seismic stratigraphy. Seismic reflections follow geologic time lines of detailed physical bedding surfaces. Seismic data could be used for putting stratigraphy into a geologic time framework for mapping.

With determination and conviction in their new ideas, Dr. Vail and his Exxon coworkers worked out a terminology for identifying the relationship of seismic reflection patterns to worldwide chronostratigraphy and took steps to both publish and teach "sequence stratigraphy" to geoscientists all over the world, starting with the classic AAPG Memoir 26, published in 1977.

As his coworker Robert Mitchum put it: "He simply has changed how people think and, more importantly, how they work on a daily basis in the broad field of stratigraphy and applied geology."

Peter Vail was born in New York City in 1930 and went to high school at Deerfield Academy in Massachusetts. He graduated from Dartmouth College in 1952. Vail attended Northwestern University for graduate degrees on a teaching assistantship and Shell fellowship grant from 1952 to 1956, where he earned both MS and PhD degrees. As a graduate student at Northwestern, he studied under legendary geology professors William Krumbein, Laurence Sloss and Edward Dapples. Dr. Sloss, at this time, was developing his theories on continent-wide cratonic mega-sequences bounded by worldwide major unconformities.

Geo-Legend Peter R. Vail *continued on page 21*

Geo-Legends continued from page 16

Geo-Legend Albert W. Bally continued from page 16

geologist (U.S.) for Shell Oil in 1968, exploration consultant in 1976 and senior exploration consultant in 1980. While at Shell, he was involved in exploration in the U.S. offshore and onshore. During the early 1970s, his focus was the study of global geology as well as more detailed studies in the Western Cordillera and the sedimentary basins of the United States, including Gulf Coast growth faults and their effect on sedimentation and hydrocarbon traps. Over the span of his career, Bally has studied seismic and tectonics in Tibet, China, Italy, the Canadian Arctic, the Gulf of Mexico, Perdido fold belt, Morocco, Venezuela, offshore Nigeria and Romania.

Upon retirement from Shell after 27 years, he became Harry Carothers Weiss Professor of Geology at Rice University in Houston, Texas. He was department chairman at Rice early in his career, and established the department's geophysics program. His insight in melding geology and geophysics has been the hallmark of his research and teaching. A major focus of investigation has been on reconciliation of the complex structural geology of the earth's upper crust with lower crust and mantle. Bally's research activities at Rice significantly contributed to the study of regional crustal decoupling in compressional, extensional and strike-slip provinces. Bally is now Rice emeritus professor, yet very active in current research. For example, he is now co-editing a two-volume book called *The Phanerozoic Geology of the World*.

Exploration geologists are grateful to Bally for publishing illustrated seismic lines from petroleum areas all over the world to illustrate the best ways to interpret difficult seismic terrains. Bally's concept of the seismic atlas as workbook was groundbreaking. *Seismic Expression of Structural Styles: A Picture and Work Atlas* (AAPG Studies in Geology, 1983) is a three-volume set that illustrates practical seismic interpretation in worldwide extensional provinces, compressive/strike slip systems and rifts/passive margins. His second work, *Atlas of Seismic Stratigraphy* (AAPG Studies in Geology #27, 1987–89), is a multivolume set that describes interpretation procedures and key definitions of sequence stratigraphy in rift systems, passive margins, the Gulf of Mexico, foredeep environments, active margins and deep sea environments.

Bally has been president of the Geological Society of America (1988) and initiated the famous Decade of North American Geology (DNAG) publication series. In the 1980s, he was part of the JOIDES Ocean Deep Drilling Project and COCORP continental reflection profiling projects. He has received many prestigious awards including the Sidney Powers Medal from the AAPG (1998), OTC Distinguished Achievement Award (2003) and Career Contribution Award for Structural Geology and Tectonics from the Geological Society of America (1998). From 1990 to 1992, he was president of the Inter-Union Commission of the Lithosphere.

We are honored that Albert Bally is a Geo-Legends panelist because he taught so many how to visualize and explain the deformation history of complex subsurface structures. Because of his long career at Shell Oil, he knew that working geoscientists use diagrams and pictures as communication tools, and that illustrations can sometimes teach more effectively than text. ■

Geo-Legend Arnold Bouma continued from page 16

1962–1963 for a year on a Fulbright post-doctoral fellowship. In 1966, Bouma and his family immigrated to the United States to accept a professorship in oceanography at Texas A&M University, where he taught until the end of 1975. He recalls that the job market for geology students was not good in the mid-1970s. From 1975 to 1981, he was a research marine geologist with the U.S. Geological Survey, first in the Pacific-Arctic branch and later in the Atlantic-Gulf of Mexico branch. One reason he joined the USGS was so that he could help his students get employment.

Between 1981 and 1985, Bouma worked for Gulf Oil, first as a senior scientist, then manager, chief scientist and acting vice president for Gulf Research and Development Company. In 1985, Gulf Oil was bought by Chevron, and Bouma became a senior research associate at Chevron Oil Field Research Company (research and development branch) in Houston, Texas, and La Habra, California. He organized Leg 96 (a deep-ocean expedition) of the Deep Sea Drilling Project in 1980–1985. He even helped to produce the BBC-AAPG film "Deep Water Sands" in 1985–1986.

He left Chevron in 1988 to become the Charles T. McCord chaired professor of petroleum-related geology at Louisiana State University in Baton Rouge, where he taught for many years until just recently. Bouma was director of the Basin Research Institute and head of the School of Geosciences at Louisiana State University in 1989–1990 and 1990–1992, respectively. The LSU Office of Research & Graduate Studies recently honored Bouma as a winner of the 2003 Distinguished Research Master Award. Bouma has been a distinguished lecturer for the AAPG, and he also won Best Paper Award at the AAPG Annual Meeting in 1984. Other awards include the Francis P. Shepard Award from the SEPM in 1982 and the Outstanding Education Award from the Gulf Coast Association of Geological Societies (GCAGS) in 1992. Arnold Bouma was president of the Society for Sedimentary Geology (SEPM) from 2000 to 2001. In 2003, the Gulf Coast Association of Geological Societies dedicated a volume of its journal to Bouma, in recognition of the Bouma sequence and his work as an "inspirational educator for students in sedimentology and stratigraphy." **Geo-Legend Arnold Bouma** continued on page 21

GULF COAST ASSOCIATION OF GEOLOGICAL SOCIETIES
GULF COAST SECTION OF SEPM

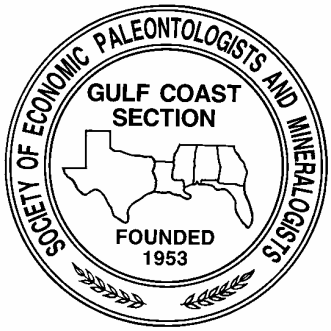
CALL FOR PAPERS

56th ANNUAL CONVENTION

LAFAYETTE, LOUISIANA

HOSTED BY THE LAFAYETTE GEOLOGICAL SOCIETY

September 25th – 27th, 2006



Come on down and pass a good time in Lafayette, Louisiana, the Heart of Acadiana and Cajun Culture! We guarantee good food, good music, and of course a good show! We are pleased to announce our convention theme, **"Visualize the Possibilities"**. Lafayette is host to the Louisiana Immersive Technologies Enterprise (LITE), a state-of-the-art 3-D visualization center currently under construction in the University of Louisiana Research Park. Their new 3-D Immersive Auditorium will be showcased as an integral part of the convention. We thus invite submission of abstracts for presentations related to all facets of Gulf Coast geology and technology, and especially encourage submission of abstracts related to visualization methods and technology. So come on down to "Visualize the Possibilities" firsthand and experience the "joie de vivre" of south Louisiana.

THEMES FOR SUBMISSION

Presentations on all aspects of Gulf Coast geology are welcome.
We especially invite presentations with the following themes:

3-D Visualization Technology and Methods — **Gulf Coast Case Histories**

Salt and Faults — **Sub-Salt Environments** — **Deep Water Systems**

Onshore Trends and Exploration — **Seafloor and Shallow Mapping and Hazards**

Coal Bed Methane — **Tight Gas Sands** — **Outcrop Studies and Analogues**

Impact of Natural Disasters — **Environmental and Coastal Studies**

HOW AND WHEN TO SUBMIT

Abstracts of proposed presentations must be submitted in standard format (250 words or less; no figures or references) by **Jan. 16, 2006**. There are two ways to submit abstracts:

1) Connect to the GCAGS 2006 website, http://www.gcags2006.com and follow the instructions.

2) Mail a diskette or CD with the abstract in a .doc format, and a short note indicating your address, phone number and e-mail address. Also, indicate your preferred theme and preferred mode of presentation to:

GCAGS 2006 ABSTRACTS, 7190-C Cemetery Highway, St. Martinville, Louisiana 70582

Oral, poster, visualization, or core presentations will be accepted. Authors will be notified of acceptance on February 20, 2006. All presenters must submit a paper of <11 pages, or an extended abstract with key figures of ~2-4 pages by April 11, 2006. These will be published in the *Transactions*. Instructions will be posted on the GCAGS2006 website.

ABSTRACT DEADLINE: JAN. 16, 2006! Questions should be directed to James Willis at gcagstech@msn.com.

Geo-Legends continued from page 17

Geo-Legend Arnold Bouma continued from page 19

In 2005, Dr. Bouma realized that he and his family wanted to return to Texas A&M. His position as adjunct professor at the Department of Geology & Geophysics at TAMU will make it possible for him to lead field trips and to start a new project, a Shale Studies Center, located at Texas A&M University, where he plans to set up a new system for shale studies using industry cores and outcrops and involving geology and engineering students. He wants to investigate what creates shale and how shale becomes oil and gas. Research findings of oil and gas in shales make it clear that we know very little of the conditions required to make deposits good source rocks. Bouma is developing a consortium of oil companies and geological-geophysical-geochemical-engineering groups to study shale deposits.

The HGS is honored that Arnold Bouma is part of our Geo-Legends panel and wishes to recognize his life-long work in understanding the mechanics and history of deepwater sand deposition and his tireless work in making deepwater sand research understandable and beneficial to the oil and gas exploration community. ■

Geo-Legend Peter Rose continued from page 17

involved in the design and implementation of comprehensive exploration risk analysis systems for the executive management of many major and independent oil companies, operating in both the domestic and international theaters. Rose became well known to AAPG members for his monthly column in the *AAPG Explorer* during 2001 to 2003 called "The Business Side of Geology" and for his book *Risk Analysis and Management of Petroleum Exploration Ventures* (AAPG Methods in Exploration Series #12). He has written more than 90 oral papers and posters presented to various geological societies as well as national and international geological conferences.

Today, Peter Rose is currently the 89th president of AAPG, the culmination of many years of service to AAPG and local geological societies including: RMAG vice president (1975); Society of Independent Professional Earth Scientists-Austin Chapter chairman, 1990; Ad Hoc Committee for Registration of Texas Geologists, 1992–97; GCAGS general chairman, 1994 Convention; GCAGS president 2001–02; GCAGS Board 2000–03; and GCAGS Honors and Awards Committee 2003–06. He has received the AAPG Distinguished Service Award (1996), AAPG Honorary Membership (2002), AAPG Best International Paper Award (1997), AIPG Ben Parker Memorial Medalist (1998) and DPA Distinguished Service Award (2000).

The HGS is honored to have Peter Rose, current president of AAPG, on the Geo-Legends panel because of his dedication to teaching the business side of geology to geoscientists. ■

Geo-Legend Peter R. Vail continued from page 17

Luckily for the oil business, Vail went to work in 1956 as a research geologist with the Carter Oil Company, an Exxon affiliate in Tulsa, Oklahoma. He relocated to Houston in 1965, at Esso Production Research Company, now ExxonMobil Upstream Research Company, and advanced to senior research scientist, the highest technical position. His oil company studies in the 1960s involved well logs and outcrops, including review of the famous Eocene-Miocene unconformity in the Maracaibo Basin of Venezuela. Vail recognized log patterns that he later called "onlap." Vail spent several difficult years at Exxon in the 1960s and 1970s, struggling to integrate seismic reflections with well logs while developing a set of theories that were often not completely understood or supported by other geophysicists at the company.

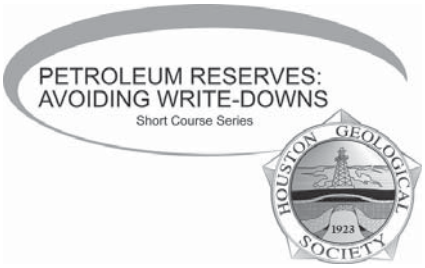
Vail became the leader of an Exxon research group that worked on inventing fundamental concepts in seismic facies analysis and worldwide sea-level fluctuations. The first outside presentations of these concepts were made at a Geological Society of America (GSA) convention in 1975. In 1977, AAPG Memoir 26 was published, marking the first outside publication on Exxon's seismic stratigraphy techniques. It became one of AAPG's best-selling technical books. Interested people can get the updated AAPG publication called *Introduction to Seismic Stratigraphy* co-written with Rick Sarg, which uses the Guadalupe Mountains of West Texas to relate seismic data to the outcrop.

After retiring from Exxon in 1986 with 30 years of service, Dr. Vail started a distinguished academic career as W. Maurice Ewing Professor of Oceanography at Rice University, until he became emeritus faculty member in 2001. He has a web page dedicated to his continuing research and oil and gas projects at http://www.prvail.com. Numerous former students and faculty at Rice recently honored him at the "Vail Fest" symposium of technical papers in 2002. Peter Vail's awards include the AAPG 2003 Sidney Powers Award, GSA Penrose Medal, Virgil Kauffman Gold Medal of the SEG, AAPG President's Award and Matson Award for best papers, Individual Achievement Award from the Offshore Technology Conference, and Twenhofel Medal by the Society of Sedimentary Geology (SEPM). He has been a prolific contributor to professional literature, having authored more than 60 publications appearing in journals, textbooks and guidebooks.

We are honored to have Dr. Peter Vail as a member of our HGS Geo-Legends panel. He saw seismic reflections in a new way—as part of a worldwide record. ■

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
Sold only as a set, Part IV will be mailed to early purchasers after the presentation of the course on September 21, 2005.

Price for the set of four CDs:	**$120.00** US
plus postage and handling	$10.00 US
TOTAL	**$130.00 US**

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Houston Geological Society
10575 Katy Freeway, Suite 290
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Monday, December 12, 2005

HGS Joint General and North American 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 ***Michael R. Hudec*** *(speaker),* ***Martin P.A. Jackson,*** *and* ***Daniel D. Schultz-Ela***
Bureau of Economic Geology,
Jackson School of Geosciences,
The University of Texas at Austin

AAPG Matson Award paper, AAPG 2005 annual meeting, Calgary

A Compressional Origin for Minibasins near the Sigsbee Scarp, Gulf of Mexico

The conventional explanation for minibasin subsidence is that it is driven by gravity—that minibasins exist because their fill is dense enough to sink into the underlying evaporites, expelling salt into the adjacent salt highs. This explanation is valid if the average density of the sediments is greater than the density of the salt, but it cannot account for subsidence of thin, less dense clastic sequences into salt. Seismic data show that many minibasins started sinking into salt when their siliciclastic fill was much thinner than the 1.5- to 2-km thickness necessary for compaction to invert the density contrast. For such minibasins, some mechanism other than gravity must be involved.

We investigated mechanisms of minibasin subsidence using a 3,600-km^2 prestack depth-migrated 3D seismic dataset near the Sigsbee Scarp, northern Gulf of Mexico. This dataset covers 27 minibasins of varying size and thickness. These data indicate that minibasin initiation was synchronous with shortening, as indicated by the presence of thrust faults in the deeper parts of many minibasins (Figure 1). A compressional origin of minibasins is also consistent with finite-element models showing that laterally shortened minibasins will subside even if their fill is less dense than the salt.

The sedimentary fill of compressional minibasins can be divided into three stages (Figure 1): (1) prethrusting, which is typically shale-prone and may predate the existence of a basin, (2) synthrusting, in which sands are deposited in synclinal subbasins between thrusts, and (3) postthrusting, in which sand bodies may extend across the entire minibasin. Understanding minibasin evolution can therefore improve prediction of reservoir continuity in suprasalt plays.

The specific cause of shortening that led to minibasin formation is currently unknown.

HGS Joint General and North American Dinner Meeting

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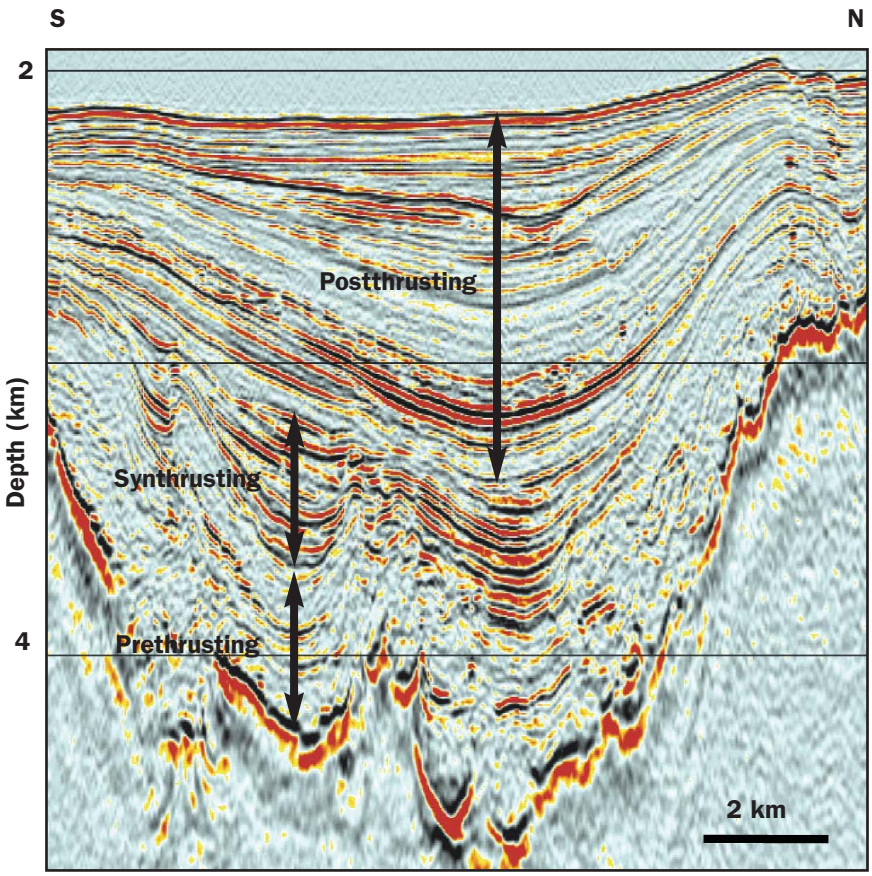

Figure 1. Thrust faults affecting the deep section in many minibasins indicate that these basins formed in compression. Reservoir distribution within the minibasin depends on whether the sands were deposited prethrusting, synthrusting, or postthrusting. Data © Veritas Marine Surveys, Houston, Texas.

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The specific cause of shortening that led to minibasin formation is currently unknown. The orientation of thrust structures is highly variable. Their pattern suggests that shortening was partitioned by flow boundaries defined at shallow levels within and above the salt sheet. If so, suprasalt processes may have been an important control. ■

Biographical Sketch

Mike Hudec received his PhD from the University of Wyoming in 1990 and spent the next eight years at Exxon Production Research, where he specialized in salt tectonics, extensional tectonics and seismic interpretation. He moved to Baylor University in 1997 as an assistant professor in Structural Geology. In 2000, Hudec moved to the Bureau of Economic Geology, where he is codirector of the Applied Geodynamics Laboratory, an industry-funded research consortium studying salt tectonics. His current research interests include advance mechanisms for salt sheets, processes in minibasin initiation and construction of a digital atlas of salt tectonics.

Martin Jackson received his PhD from the University of Cape Town in 1976, taught at the University of Natal and joined the Bureau of Economic Geology in 1980. He established and co-directs the Applied Geodynamics Laboratory. His current research interests include salt-sheet emplacement mechanisms, passive-margin tectonics and behavior of salt in orogenic belts.

Dan Schultz-Ela specializes in numerical modeling and analysis of salt structures. He taught for two years at Colorado College after receiving his PhD from the University of Minnesota for strain analysis of an Archean greenstone belt. Prior work included an MS degree from Brown University and a BA degree from Carleton College. He was a member of the Applied Geodynamics Laboratory from 1989 to 2003. He currently lives and works in Colorado.

Thursday, December 15, 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 before the meeting (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 **Janok P. Bhattacharya***
Robert E. Sheriff Professor
of Sequence Stratigraphy
University of Houston
Houston, Texas

Martian River Deltas and the Origin of Life

There remains significant room for debate as to whether there were persistent water flows, significant precipitation and standing water bodies during the early Noachian history of Mars. Recent Mars Global Surveyor (MGS) Mars Orbiter Camera (MOC) images of meandering channels associated with a Noachian-age, lacustrine delta within Holden NE Crater show evidence for persistent water flows.

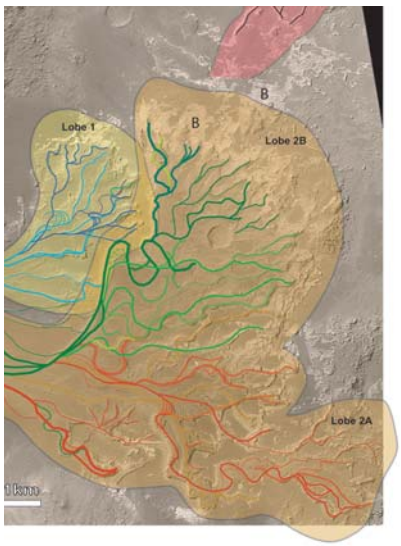


Figure 1. Map of 3 billion year-old overlapping delta lobes and channels at northwestern margin of Holden NE Crater fill (from Bhattacharya et al., 2005, GRL).

The topmost layer shows clear evidence of meandering streams associated with four depositional lobes. The channels record a complex history of migration, avulsion and bifurcation, forming a distributive pattern with up to five orders of branching. Several channels show a distinct transition from initially straight, to highly sinuous, followed by classic chute cutoffs.

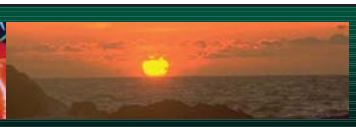
Relatively smooth and more brightly reflective layers deeper in the crater fill may represent flatter-lying lacustrine bottom sets and could speculatively be evaporitic. The transition from smooth lower layers lacking channel belts to straight channels to meandering channels suggests a progressive evolution of the sedimentary fill.

Our analysis of the surface features, as well as estimates of accumulation rates of the underlying 150 meters of strata within the crater fill, suggests that Holden NE Crater may have contained a lake that persisted for a few thousand to possibly as long as a few million years. This supports the hypothesis that early Mars was both warmer and wetter during the Noachian. In addition, these sediments represent a probable watery habitat that should be investigated for evidence of possible extinct Martian life. ■

SIPES Luncheon Meeting *continued on page 41*

December 2005

Sunday	Monday	Tuesday	Wednesday
	Members Pre-registered Prices: General Dinner Meeting .....$25 Nonmembers walk-ups..... $33 Env. & Eng. .....$25 Luncheon Meeting .....$30 Nonmembers walk-ups..... $33 International Explorationists .....$25 North American Expl. .....$25 Emerging Technology $25	**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.**	
4 **25TH Annual GCSSEPM Foundation Bob F. Perkins Research Conference** Page 42	5	6 **HGS Executive Board Meeting**	7
11	12 **HGS Joint General and North American Dinner Meeting** by M. Hudec (speaker), M.P.A. Jackson and D.D. Schultz-Ela *"A Compressional Orgin for Minibasins near the Sigsbee Scarp, Gulf of Mexico"* Page 23	13	14
18	19	20	21
25 *Christmas*	26	27	28

GeoEvents

Thursday	Friday	Saturday
1	2	3
8	9	10
15 **SIPES Luncheon Meeting** by J.P. Bhattacharya *"Martian River Deltas and the Origin of Life"* Page 26	16 **HGA Christmas Luncheon** Page 52	17
22	23	24
29	30	31 **NOW you can make your reservations on-line at www.hgs.org**

Upcoming GeoEvents

Monday January 9
General Dinner Meeting
Geo-Legends *Page 15*

Monday January 16
International Dinner Meeting

Tuesday January 17
Northsiders Luncheon Meeting

Tuesday January 17
Environmental and Engineering Dinner Meeting Environmental *Considerations in Coalbed Methane and Tight Gas Sands*

Monday January 23
North American Dinner Meeting

Wednesday January 25
HGA Luncheon

Thursday January 25
GeoWives HMNS Fieldtrip *Page 52*

February 1-3
North American Prospect Expo
George R. Brown Convention Center, Houston, TX

February 6-10
3rd Annual AAPG Winter Education Conference
Hilton Houston Westchase Hotel
Houston, TX *Page 10*

March 5-9
2006 APPEX London *Page 44*

April 9-12
2006 AAPG Annual Convention
George R. Brown Convention Center, Houston, TX

The Great Sumatra-Andaman Earthquake of December 26, 2004: New Insights That Will Change the Next 40 Years and the Plate Tectonic Paradigm

by ***Arthur E. Berman***

Nearly one year ago, the Great Sumatra-Andaman Earthquake produced the most destructive tsunami in history, with 283,000 people dead or missing in the Indian Ocean region. Modern geophysical data recorded during the earthquake and tsunami revealed unprecedented complexity in the mechanics of plate boundary rupture. No inversion model successfully accounts for the slip or rupture pattern produced by this event. New understanding of plate boundary behavior and mechanics that arises from the Great Sumatra-Andaman Earthquake may ultimately modify the existing plate tectonic paradigm.

The most remarkable aspect of the Great Sumatra-Andaman Earthquake was the slow slip that followed the initial, rather characteristic rupture and unzipping of a plate boundary.

The earthquake initiated just before 8:00 a.m. local time at the epicenter on the morning of December 26, 2004, approximately 255 km (158 mi) south-southwest of Banda Aceh off the western coast of northern Sumatra (Figure 1). There was no warning for the earthquake or the ensuing tsunami that rapidly reached the shores of the Indian Ocean, devastating coastal areas of Indonesia, Thailand, Myanmar, India and Sri Lanka.

An Exceptional Earthquake

The Great Sumatra-Andaman Earthquake was exceptional in every way. Its 1300-km (807-mi) rupture length is the longest of any known earthquake (Hanson, 2005). The rupture zone was as much as 240 km (149 mi) wide (Lay and others, 2005). The rupture lasted over an hour, making it the longest known rupture period of any earthquake (Hanson, 2005). It deformed an entire hemisphere, moving global positioning system (GPS) stations in southern India 4 m (13 ft) with peak-to-peak ground motion over 9 cm (3.5 in) in Sri Lanka (Bilham, 2005). No point on Earth was undisturbed, with peak ground motion greater than 1 cm (0.4 in) everywhere (Park and others, 2005).

The Great Sumatra-Andaman Earthquake was the second largest earthquake in instrumental history releasing 4.3 × 1018 J (Bilham, 2005). This is approximately equivalent to a 100-gigaton nuclear explosion or the total energy used in the United States in 6 months. The tsunami produced by the earthquake displaced 30 km^3 (7.2 mi^3) of sea water (Bilham, 2005). The 9.3 moment magnitude (Mw) of the earthquake was equal to the sum of all moment magnitudes of earthquakes during the decade that preceded it (Lay and others, 2005). The earthquake and tsunami killed more people than any other natural disaster in history.

The Great Sumatra-Andaman Earthquake was also exceptional as the first very large earthquake to be recorded and measured by a spectrum of digital technologies that were not available during other large earthquakes of the 20th century. Previous great earthquakes—the 1960 Chile Earthquake (Mw = 9.5) **The Great Sumatra-Andaman Earthquake** *continued on page 33*

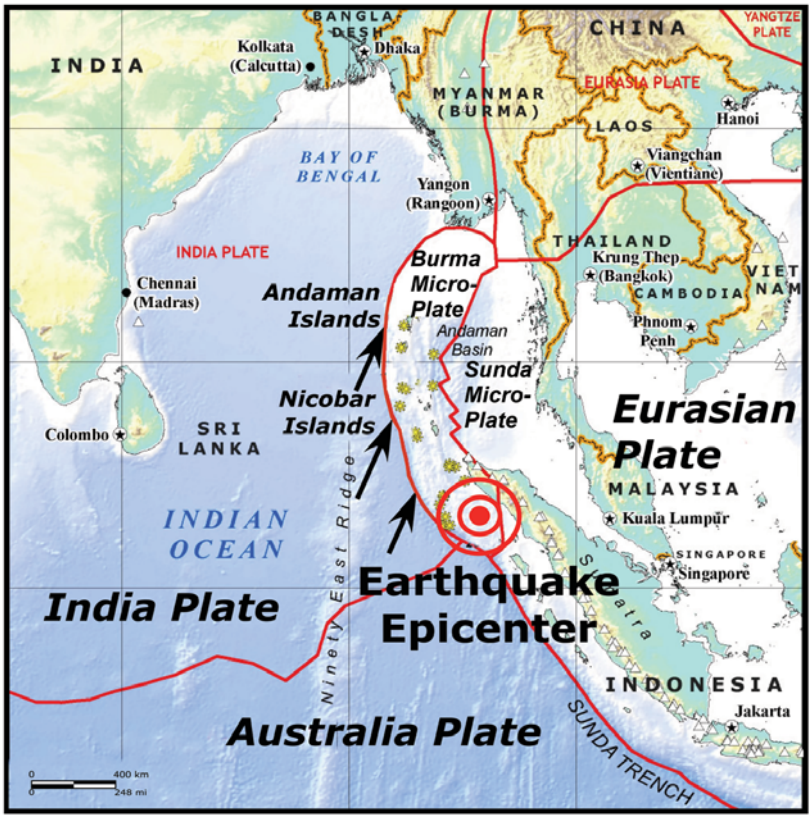


Figure 1. Northeastern Indian Ocean tectonic elements. Modified from USGS Preliminary Earthquake Report, (2004).

The Great Sumatra-Andaman Earthquake

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and the 1964 Alaska Earthquake (Mw = 9.1)—saturated existing analog measurement and recording equipment. The Sumatra-Andaman event was recorded by a global network of broadband, high dynamic range, digital seismometers. It was the first major earthquake to be monitored by the GPS. In addition, it was the first application of digitally recorded, long-period, free-oscillation modal geophysics.

A moment magnitude of 9.0 was initially calculated for the Great Sumatra-Andaman Earthquake. In March 2005, researchers at Northwestern University determined that the true magnitude was 9.3—approximately 3 times the energy released by a 9.0 event—after taking into account the full length and slip of the rupture, particularly the "slow slip" of the rupture's northern portion (Fellman, 2005).

Rupture Segmentation and Slow Slip

The December 2004 earthquake trajectory may be divided into three segments, along with a fourth segment created by the contiguous March 2005 Nias Earthquake (Figure 2). Rupture initiated at a depth of about 30 km (18.7 mi) within the Sumatra segment. Rupture speed was slow and slip was small for the first 50 seconds. Rupture then expanded over the approximate 420 km (261 mi) of the Sumatra segment at an average speed of 2.7 km/s (1.7 mi/s) and rapid slip of between 5 and 20 m (16.4-65.6 ft) (Lay and others, 2005).

From 230 to 350 seconds, rupture progressed along the 325-km (202-mi) Nicobar segment of the earthquake with an average 5 m (16.4 ft) of rapid slip and an average rupture speed of 1.1 km/s (0.7 mi/s). In the Nicobar segment, an additional 5 m of slow slip proceeded up to 3500 seconds after rupture initiation (Lay and others, 2005).

The Andaman segment of the December rupture was characterized by less than 2 m (6.6 ft) of slip from 350 to 600 seconds after rupture initiation. An additional 5 m of slow slip occurred from 600 seconds to more than 3500 seconds. Rupture speeds in the northern segment were only about 0.3 km/s (0.2 mi/s) (Lay and others, 2005). The most remarkable aspect of the Great Sumatra-Andaman Earthquake was the slow slip that followed the initial, rather characteristic rupture and unzipping of a plate boundary. Slow slip tripled the earthquake's energy release and accounts for the revision of its moment magnitude from 9.0 to 9.3. Slip along the northern segments of the rupture zone occurred too slowly to generate tsunami waves. Had slip been as rapid on the Nicobar and Andaman segments of the rupture as on the Sumatra portion, the resulting tsunami would have been many times more devastating than what actually occurred.

The March 28, 2005, Nias Earthquake may be thought of as a large, late aftershock. It had a moment magnitude of 8.7 and an average 8 m (26.3 ft) slip along a 300-km (186.5-mi) segment. It was probably produced by plate boundary failure because of stress changes that resulted from the December 26 rupture. No significant tsunami was produced by this rupture.

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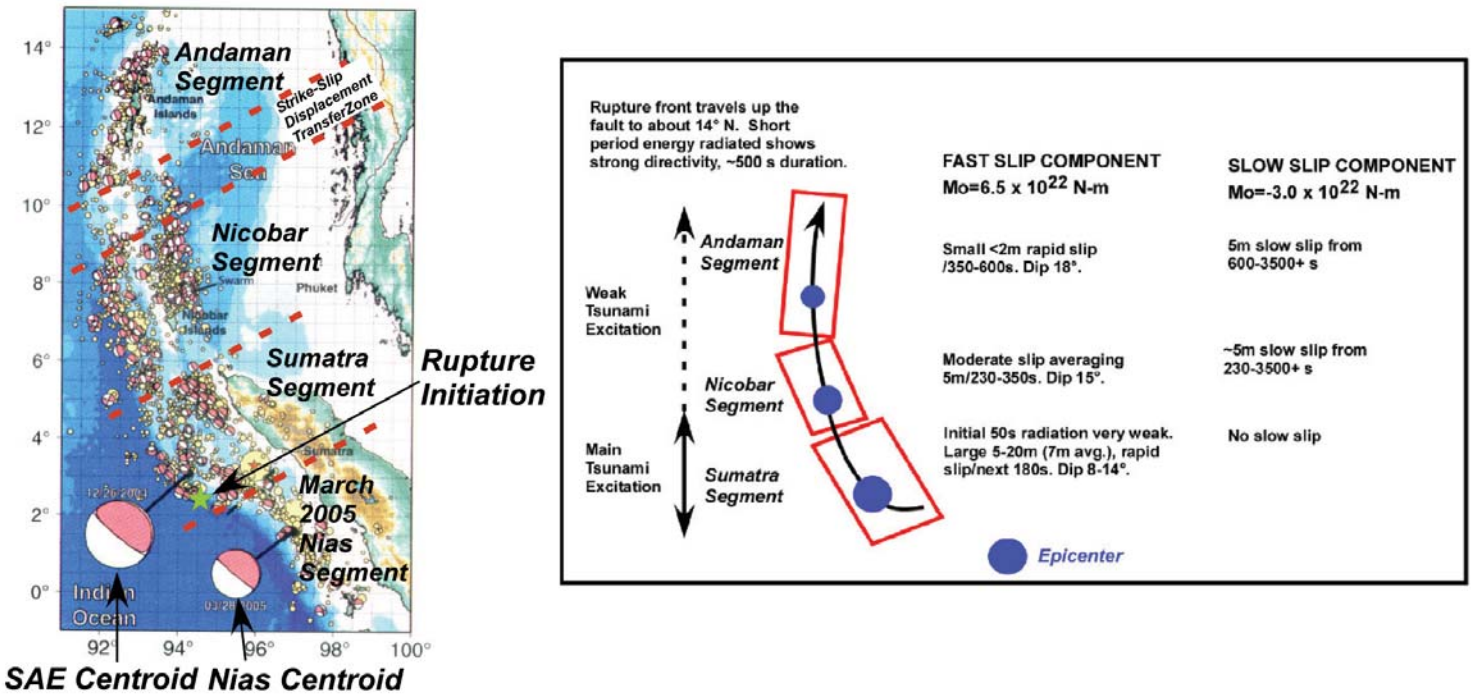

Figure 2. December 26, 2004, Sumatra-Andaman Earthquake (SAE) rupture segmentation. Modified from Lay and others (2005).

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Slow slip is poorly understood and its causes are largely empirical at present. Slow slip occurred where plate convergence became increasingly oblique. It also coincided with a change in age of the subducting lithospheric plate from 60 Ma to 90 Ma between the Sumatra and Andaman rupture segments. Age and accompanying textural differences may have resulted in changes in mechanical coupling along the fault plane: subduction of younger lithosphere may have provided a broader contact area (Lay and others, 2005). Subduction of older lithosphere to the north may have contributed to displacement transfer across zones of previous back-arc spreading and associated dispersion of rupture energy (Figure 2).

Slow slip excited several of Earth's fundamental resonances called free vibrational oscillations. Free oscillations were first reported after Fourier analysis of digitized analog seismic records from the 1960 Chilean earthquake. When seismic waves of different frequencies are diffracted back toward Earth's surface, resonances are formed when these waves interfere constructively (Figure 3). Records from more than 400 stations of the Federation of Digital Seismic Networks were used to observe free oscillations during the Great Sumatra-Andaman Earthquake. Vibrational modes provide information about the composition of the Earth as well as the size and duration of the earthquake.

"Just like thumping a watermelon to hear if it is ripe, after a big earthquake thumps our planet, we measure the natural tones from seismograms to detect properties of Earth's deep mantle and core," said Jeffrey J. Park of the Department of Geology and Geophysics at Yale University. "The Sumatra-Andaman earthquake produced the best documentation of Earth's free oscillations ever recorded" ("Thumping the Earth like a Watermelon," 2005).

Complicated Modeling

Moment magnitude or finite rupture modeling was the geophysical standard prior to the Great Sumatra-Andaman Earthquake. These models were based on a single, stable fault offset. Long-period seismic surface waves in the 100- to 300-second range were used to produce an inversion that seemed to satisfy the relatively simple yet robust models provided by the plate tectonic model. Finite rupture was the preferred model run in late December and early January following the Great Sumatra-Andaman Earthquake. Harvard Centroid Moment Tensor (CMT) models that yielded a 9.0-moment magnitude were typical of the generation of modeling that included the two great earthquakes in Chile and Alaska during the second half of the 20th century. For the Sumatra earthquake, assumptions included a uniform slip of 5 m along a 1300-km fault whose width varied between 100 and 240 km and a uniform rigidity factor. This method did not account for well-documented geodetic observations in the Andaman and Nicobar islands regions or the dispersal patterns and magnitude of the tsunami that followed the earthquake.

Geophysicists began to unravel the new, very long-period seismic and geodetic data acquired in late 2004 and early 2005 to reach a more satisfactory solution. It was soon learned that little or no conventional body or surface seismic waves were generated during much of the extremely long period rupture process in the Indian Ocean. More complicated models or series of models were therefore required to approximate both geodetic and tsunami-related observations. The modeling process was, to say the least, experimental. The results of the modeling were understandably not entirely convincing. It could be argued that, without knowing the answer, modeling could not have achieved even the less-than-satisfactory solutions we now have.

The problems that result, of course, from using magnitude to quantify earthquakes are a direct consequence of trying to summarize a process as complex as an earthquake in a single number. In the case of the Indian Ocean event there was, perhaps

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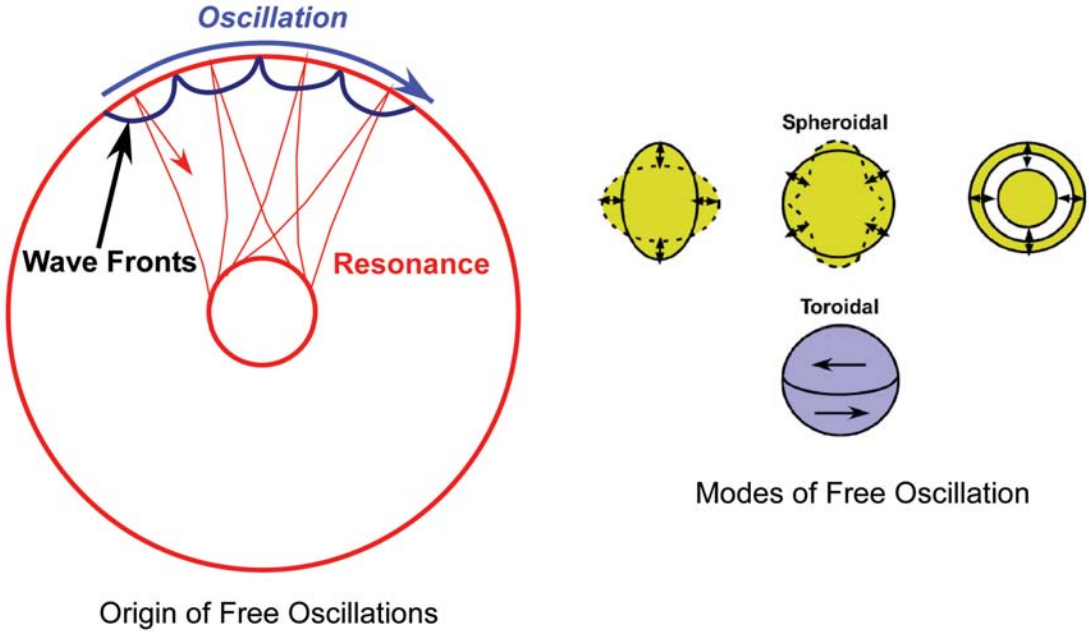

Figure 3. Free oscillations. Modified from Park and others (2005) and Cacciani and DeSalvo (2005).

The Great Sumatra-Andaman Earthquake continued from page 35

for the first time in history, enough data to characterize this complexity. The possible casualty of this information extravaganza may be our revered plate tectonic paradigm.

The overload of data that was produced by the Great Sumatra-Andaman Earthquake reminds me of the expectations that many oil companies have had with 3D seismic. If a prospect seems complicated with only 2D coverage, many companies have hoped and assumed that 3D seismic data would make things clear. Generally the opposite occurs. A confusing situation often becomes overwhelmingly complex when all the details can be imaged using 3D.

Without going into the details of the modeling geophysics, the Great Sumatra-Andaman Earthquake was a compound process of seismic energy release that involved variable slip amplitudes, rupture velocities, and slip durations. Most of the slip occurred in the southern third of the rupture region, with diminishing rapid slip that became increasingly slower toward the north. The causes for these variables are poorly understood at present.

Seismic finite rupture models that most closely agree with empirical observations are complicated and use teleseismic (distantly observed) waveforms to determine moment magnitude (P or body wave, Rayleigh and SH, or second harmonic, surface wave magnitudes). No fewer than three separate models were required to account for the Sumatra-Andaman slip and rupture patterns. Each method involved different parameterization of seismic source as a function of time and restricted fault plane slip to specific time windows for each step of the model.

In some areas, modeling efforts using free oscillation geophysics provided a better match between observed and predicted responses than the seismic finite rupture models. On the other hand, oscillation mode models had to rely on seismic body and surface waves as well as GPS data to achieve a reasonable solution. Part of the weakness in this interesting approach to earthquake modeling is that free oscillation information was not produced until the slow slip phase of rupture began. In other words, free oscillation models could not begin until the late, northern phases of the Sumatra-Andaman Earthquake occurred. This solution, incidentally, results in a full 4.5 degrees northerly shift of the earthquake's centroid (the 3D center of energy release), an adjustment of nearly 500 km (311 mi)!

Equally laudable and unsatisfying models were generated using geodetic GPS data from 41 continuously operating reference stations in the Indian Ocean region. This approach yielded an average calculated slip of slightly greater than the 5 m used by the Harvard CMT models and an accompanying 40% increase in moment magnitude of 9.1 (though less than the 9.3 calculation that resulted from the free oscillation models). The drawbacks to the GPS approach were two-fold: first, only the horizontal component of global position was used to resolve a mostly vertical problem owing to the limits of vertical resolution using GPS methods; second, data for the model began five days after rupture initiation because of uncertainties introduced during reclamation of GPS surface sites.

Modern instrumentation provided a broad frequency spectrum of time-variable seismic data, free oscillation, and geodetic information not available in prior large earthquakes. Efforts to cope with the apparent complexity of the Sumatra-Andaman event have produced complicated models which try this layman's ability and willingness to accept. The models still do not account for important observations.

Problems with the Explanation and What Has Been Learned

The various models that I have summarized contain substantive flaws. The principal problem is that the seismic model does not account for 3 to 7 m (10 to 23 ft) of slip over 160 km (99 mi) of the Andaman and Nicobar fault segments. This was because slip in these regions occurred on a time scale beyond the normal seismic band and generated little seismic response. Geodetic constraints require two to three times more slip on this northern rupture portion than the seismic model provides.

The most important thing learned from the Great Sumatra-Andaman Earthquake is that the complexity and uneven aspect of fault slip in great earthquakes is at least as great as some feared, only now the complexity can be partly quantified. We have confirmed what was widely suspected: moment magnitude is not necessarily the main factor in generating tsunamis. Rapid vertical ocean-bottom displacement produces tsunamis. Only the southern one-third of this earthquake generated tsunami waves. There are apparently limits to the obliquity of plate boundary convergence beyond which rapid vertical slip is unlikely, or at least less, likely to occur. Subduction of older lithosphere, especially where strike-slip displacement transfer occurs (back-arc spreading), is less likely to produce tsunamis.

Three different and elaborate modeling approaches were taken after the initial Harvard CMT model was announced. These methods relied on teleseismic observations, free oscillation geophysics and GPS-based geodetic observations. None was fully satisfying. None was remotely successful without borrowing somewhat from at least one or both of the other methods, yet no concerted effort was apparently made to fully integrate the three approaches.

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The Great Sumatra-Andaman Earthquake

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The Russian novelist Anton Chekhov was also a physician. He said that when a patient has many symptoms, there surely can be no cure. The complexity introduced by modern recording and modeling technology has, I believe, revealed many symptoms. The plate tectonic paradigm may have reached a limit and, while still vital and useful, may need to be modified. Plate tectonics may follow a path similar to classic Newtonian physics: still useful at many scales of observation but less useful in more precise and finite domains of time and space. Some scales of observation and prediction may be beyond the simple plate model. For all of its beauty and appeal, the plate tectonic paradigm has not resolved Wegener's dilemma. Plate tectonics provided undeniable proof that Earth's crustal plates move, but it did not resolve the mechanism concisely or convincingly.

In spite of its inherent conservatism, the process of scientific observation and interpretation produces revolutions from time to time (Kuhn, 1962). While the striking feature of scientific inquiry is its intent to discover what is already known or presumed in advance, sufficient new information is revealed to overthrow most ruling theories or paradigms at some time in their histories. A paradigm is, after all, nothing more than an interpretation of observations that a particular community acknowledges for a time as supplying the basis and foundation for its further practice. Once accepted, alternatives to the paradigm are strenuously resisted. In time, however, new paradigms are grudgingly accepted partly as a reason to conduct still more self-fulfilling inquiry!

Our measurement and modeling technologies for earthquakes and tsunamis have advanced tremendously between the Alaska Earthquake of 1964 and the Great Sumatra-Andaman Earthquake of 2004. Because of the punctuated occurrence of great earthquakes, this steady advance in technology seems to have overwhelmed our understanding of tectonics almost overnight. While prediction is still not possible, probabilistic deduction becomes increasingly practical. What is needed at this moment is clearer understanding of where rapid, early earthquake displacements are most likely to occur. New observations of convergence obliquity and mechanical behavior of different lithospheric plate ages provide productive pathways to pursue for better tsunami risk assessment.

Letter From Jakarta

I received another letter from Jakarta this week. In it, my colleague Dr. Busztin György Nagykövet tells me that Indonesia is proceeding with its plan to deploy an ocean buoy sensor tsunami warning system similar to the DART (Deep-ocean Assessment and Reporting of Tsunamis) array that the United States uses along our Pacific coast. He included a photo of people inspecting a giant buoy being deployed in Jakarta's port. The system will be installed by the time this article is published.

I have previously described the obvious flaws in DART technology in its present form (Berman, 2005). The United States is at considerable tsunami risk along the Washington and Oregon coasts for all of the reasons that the Indian Ocean was at risk one year ago. With what has been learned as a result of data acquired from the Great Sumatra-Andaman Earthquake of December 2004, the danger to our northwestern coastline is amplified.

I replied to Dr. Busztin that I feared my efforts to inspire the geological community to benefit the Indian Ocean region had failed. The modern Trojans are bringing the enemy's gift inside the city walls as I write. It has been just 10 months since the inevitable Indian Ocean disaster occurred and we continue to lament our inability to predict tsunamis.

We live on a restless and often dangerous planet. Earth science has made impressive progress toward understanding those dangers in the brief history of our science. Though we cannot yet predict when or precisely where natural disasters related to geological processes will occur, we can certainly say something about the probability that some regions are at greater risk than others.

For those who live near convergent plate boundaries in the Indian Ocean and Pacific Northwest of North America, earthquakes and tsunamis will occur. We should do everything possible to use science and technology to provide early warning of these events. DART pressure sensing buoys may be part of the long-term solution but will not provide sufficient warning for coastal areas close to earthquake epicenters.

Risks must be Stated Clearly and Remedies Evaluated Honestly

Modern digital seismic methods offer the greatest potential for early tsunami warning despite the lack of direct correlation between earthquake magnitude and tsunami occurrence. The Great Sumatra-Andaman Earthquake of December 2004 has given us many new insights into this relationship. We must apply this knowledge in the study of plate boundary convergence geometries and age of subducting lithosphere in order to better understand causes of the rapid slip that produces tsunamis. In the meantime, we should promote full and appropriate utilization of seismic technology, coupled with public awareness training, to minimize the effects of tsunamis. ■

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SIPES Luncheon continued from page 25

Biographical Sketch

Dr. Janok P. Bhattacharya is the Robert E. Sheriff Professor of Sequence Stratigraphy at the University of Houston. His research interests include deltaic sedimentology and sequence stratigraphy, the local control of structure on stratigraphy and reservoir architecture of clastic depositional systems. He received his BS in 1981 from Memorial University of Newfoundland, Canada, and a PhD in 1989 from McMaster University, Hamilton, Ontario, Canada. Following a Natural Sciences and Engineering Research Council post-doc at the Alberta Geological Survey in Edmonton, Janok worked for the Bureau of Economic Geology at Austin, ARCO Research in Plano, Texas, and the University of Texas at Dallas before joining UH. He is an AAPG Southwest Section Distinguished Educator and AAPG Distinguished Lecturer and was Technical Program Chairman for the 2004 AAPG Annual meeting in Dallas. He has authored over 100 abstracts and 40 technical papers

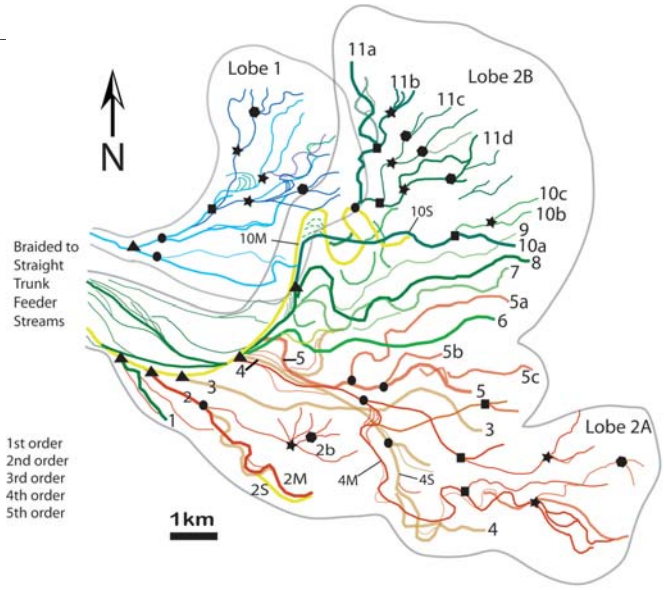

Figure 2. Details of channel patterns in lobes 1 and 2. Main channels are numbered (1-11) and subsidiary distributaries are designated with letters (11a, 11b etc.). Channel order is determined at each bifurcation point. Meandering channels are designated with the letter M. Straight channels are designated with the letter S. Newly avulsed channels typically are straight and become more sinuous with time (e.g. 4S to 4M). This reflects an extended history of water flow, consistent with coinsiderably wetter conditions in early Mars (from Bhattacharya et al., 2005, GRL).

Government Update

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

From the Texas *Register*

The Railroad Commission of Texas proposes amendments to §3.78, relating to Fees and Financial Security Requirements, to implement the provisions of House Bill 380, 79th Legislature, Regular Session (2005), which amends Texas Natural Resources Code §§91.104, 91.1041, 91.1042, 91.105, 91.107, 91.108, 91.1091 and 91.111 to authorize the Commission to accept well-specific plugging insurance policies from operators to satisfy financial security requirements for wells subject to the jurisdiction of the Commission.

A well-specific plugging insurance policy allows an insurer to use underwriting practices to evaluate a premium cost that, when combined with return on investment, would provide sufficient funding to properly plug a specific well. Other forms of financial security are based on the operator's financial resources and the operator's history of complying with its regulatory obligations. For more information go to:
http://www.sos.state.tx.us/texreg/sos/PROPOSED/16.ECONOMIC%20REGULATION.html#90

The General Land Office adopts on an emergency basis new §15.13 concerning Emergency Provisions for Stabilization and Repair of Damaged Residential Structures and new §15.14 concerning Emergency Measures for Dune Restoration and Temporary Shoreline Protection Measures. The General Land Office recognizes that the Village of Surfside Beach, Texas, has areas where residential structures are in need of emergency stabilization and repair and where emergency hazard mitigation measures are needed to reestablish the protective barrier provided by natural dunes damaged or destroyed by storm tidal surges in order to prevent imminent peril to the public health, safety and welfare. For more information go to:
http://lamb.sos.state.tx.us/texreg/sos/EMERGENCY/31.NATURAL%20RESOURCES%20AND%20CONSERVATION.html#3

Texas Commission on Environmental Quality News

The TCEQ has released Texas Risk Reduction Program (TRRP) Guidance Document TRRP-34, "Facility Operations Area." This document is available at http://www.tceq.state.tx.us/remediation/trrp/guidance.html

Texas Board of Professional Geoscientists News

The Texas Board of Professional Geoscientists (TBPG) is currently conducting and will continue to conduct compliance investigations at the TCEQ. The TBPG will be researching reports submitted to the TCEQ to ensure that geoscience work is not being performed by expired licensees or nonlicensees. In addition, any other violations discovered, which may involve current licensees, will be investigated by the TBPG.

From the AGI *Monthly Review* (September 2005)

Katrina Raises Gas Prices

Hurricane Katrina shut down about 95% of Gulf oil production and 72% of Gulf natural gas production as a result of evacuations, electricity outages, and flooding. Several refineries and platforms were also damaged by the storm and will be shut down for a longer period of time. The shut down also affected oil and natural gas pipelines from the Gulf Coast to inland distribution centers causing some gas shortages.

Gasoline prices skyrocketed in many parts of the country, rising by 50 to 75 cents per gallon within hours. In response to the supply shortages, several congressional committees held hearings to address rising energy prices.

Members of Congress offered ideas on how to protect consumers from price hikes, increase domestic supply, and exercise conservation of gasoline and natural gas.

Several energy sector representatives, who were witnesses at these hearings, called for a relaxation of oil refinery regulations and a reduction in the number of "boutique" fuel blends required in some areas during the summer months. Witnesses associated with natural gas interests pointed out a need to import more liquefied natural gas from abroad and to modify environmental laws that inhibit domestic gas production. Industry representatives also warned Congress that interfering in energy markets, for instance by establishing gasoline price caps, would create market distortion. One energy consultant, Robin West of the PFC Energy Team, also made it clear that high prices were due to high demand and not any action on the part of OPEC, the Middle Eastern oil cartel.

Many Members and other witnesses, however, insisted that the rising prices were due to price gouging and not supply-demand issues. Federal agency representatives repeatedly deflected questions about how to identify and crack down on market manipulation. Guy Caruso, Administrator of the Energy Information Administration, and John Seesel, Associate General Counsel for Energy at the Federal Trade Commission (FTC), refused to call the rising prices "price gouging" and insisted that energy trading on the futures market was the principal cause for the price hikes. Members continued to press witnesses on evidence that oil companies are making huge profits at the expense of consumers. **Government Update** *continued on page 45*

As a HGA member you are invited to join

GeoWives

2005–2006 dues are $7.50

make check payable to *GeoWives* and mail to:

Dene Grove
12715 Pebblebrook
Houston, Texas 77024

Please provide the following

Name: _____

Sreet Address: _____

_____

City/State/Zip: _____

Telephone: _____

email: _____

I will help plan a GeoWives activity ☐
I will serve on a committee ☐
Notification / Phone Committee ☐
Courtesy / Hostess ☐
My home is available for a meeting ☐

Government Update continued from page 43

Several senators, including Maria Cantwell (D-WA), Gordon Smith (R-OR) and Ron Wyden (D-OR), announced legislation designed to prevent gasoline price gouging, and senators successfully attached an amendment to the Commerce, Justice and Science appropriations bill directing the FTC to investigate and prosecute such activities.

More Energy Bills Spawned by Katrina

Several lawmakers have used the aftermath of Katrina as an opportunity to introduce new energy legislation. Two bills introduced in the House that focus on expanding domestic energy production have gained the most momentum in recent weeks.

The "Gasoline for America's Security Act of 2005" (H.R. 3893), introduced by Energy and Commerce Committee Chairman Joe Barton (R-TX), would repeal parts of the energy bill in order to provide new refinery construction incentives, and it would relax certain Clean Air Act requirements. The second bill, sponsored by House Resources Committee Chairman Richard Pombo (R-CA) takes bold steps to open up more public land and offshore areas to energy development, including a provision to allow states to opt out of offshore leasing bans and to allow drilling in the Arctic National Wildlife Refuge (ANWR). The bill also includes minor titles to provide funding for engineering and mining schools and to establish a geologic mapping and data preservation program using royalties from mining and offshore energy revenues.

While the full House was going forward with Barton's bill with a vote due on October 7, 2005, Republican leadership decided not to call a House vote on Pombo's bill; instead, the bill may be incorporated into the House budget reconciliation package, which is immune to filibuster in the Senate. Meanwhile, Senate Energy and Natural Resources Chairman Pete Domenici is expected to roll out Katrina-related energy legislation of his own later in October that will contain offshore oil and gas options and incentives to encourage energy conservation.

AAAS Brokerage System for Scientists Affected by Katrina

The American Association for the Advancement of Science (AAAS) has developed a "brokerage system" through which scientists in the Gulf Coast region can find needed resources for rebuilding their labs and classrooms. Through this online service, scientists can post needed and available resources, including computers, books, lab space or equipment, and teaching materials. Additionally, AAAS has made articles from *Science* related to hurricanes freely available as an aid to policymakers, scientists and the public. These articles include a widely publicized recent study that links global warming with increased hurricane intensity. The brokerage and the free *Science* articles are available at http://www.aaas.org/katrina/.

National Ground Water Association Recommends Emergency Registry

The National Ground Water Association (NGWA) has suggested that its members who are looking to help with recovery efforts following Hurricane Katrina join the National Emergency Resource Registry. The registry is run by the Homeland Security Operations Center (HSOC) as a way to efficiently coordinate response efforts with communities affected by Hurricane Katrina or other disasters. On the National Emergency Resource Registry website, www.seern.com, persons or companies can register as new or existing members, select "water/waste water" as a service category, and specify the type of assistance they can offer. "Our industry has a big heart, which is evidenced by the many NGWA members offering their services. We believe those who wish to volunteer should get on the emergency registry to help and not hinder the recovery effort," said NGWA Executive Director Kevin McCray.

Evolution Roundup

Dover Case Starts.

Last year the Dover Area School District in Pennsylvania adopted a requirement that school administrators deliver a statement warning students that evolution is a theory among many and pointing them towards intelligent design for alternative reading. Eleven parents were joined by the American Civil Liberties Union and the American Union for the Separation of Church and State in a lawsuit against the school district, arguing that the directive is an attempt to bring religion into science classrooms. The Dover Area School District is being represented pro bono by the Thomas More Law Center, a Christian law firm based in Michigan. The case, Kitzmiller vs. Dover, is being heard without a jury in Harrisburg by U.S. District Judge John Jones III, whom President Bush appointed to the bench in 2002.

The Discovery Institute, in a written statement before the trial, disagreed with the Dover policy to try to distance itself from a case that is likely to be decided as religious interference and unlikely to make Intelligent Design look more like a science than religion. The institute stated, "Misguided policies like the one adopted by the Dover School District are likely to be politically divisive and hinder a fair and open discussion of the merits of intelligent design among scholars and within the scientific community." Furthermore, the institute said, judges should not be telling scientists "what is legitimate scientific inquiry and what is not." The institute's website www.evolutionnews.org provides daily news about the institute's views of misrepresentation of Intelligent Design in the court proceedings.

Opening arguments in the case began on September 26, 2005, and it is possible that the case could end up in the Supreme Court through the appeal process. **Government Update** continued on page 47

Government Update continued from page 45

Transcripts, webcasts, and daily updates on the trial from the National Center for Science Education are available at http://www2.ncseweb.org/wp/

Congressman Rush Holt Decries Intelligent Design

In a September 8, 2005, blog titled "Intelligent Design: It's Not Even Wrong," Representative Rush Holt (D-NJ) responded to President Bush's statement of support for the teaching of Intelligent Design alongside evolution. Holt, who is a physicist, pointed out that Intelligent Design, because it cannot be tested empirically, is not science and therefore should not be taught as such. "We must not allow this American intellectual habit to be replaced with wishful thinking or lazy thinking," wrote Holt. "Intelligent design is lazy thinking." Holt also argued that instead of debating the teaching of this nonscientific concept, Americans should be finding ways to improve our faltering education system. President Bush's comments were made on August 1, and many scientific societies, including the American Geophysical Union, responded with statements declaring Intelligent Design to be unscientific. Representative Holt's blog is available at http://www.agiweb.org/gap/legis108/evolution_holt0905.html.

Museums Providing Training for Challenges from Creationists

In a story printed on September 20, 2005, the *New York Times* detailed how museum docents are handling an increasing number of challenges to exhibits on evolution. Dr. Warren Allmon, who is the Director of the Paleontological Research Institution, one of AGI's Member Societies, has held training sessions for docents on ways to deal with visitors who reject scientific theories for religious reasons. "Just telling them they are wrong is not going to be effective," Allmon said. Similar steps are being taken at museums across the country as the debate over evolution becomes more heated.

American Astronomical Society Issues Statement Supporting Teaching Evolution

On September 20 the American Astronomical Society (AAS) issued a statement in support of teaching evolution in America's K-12 science classrooms. The statement points out that the theory of evolution is a foundation of modern science, and that Intelligent Design does not meet the criteria of a scientific idea. AAS President Dr. Robert Kirshner said, "Science teachers have their hands full teaching the things that we actually know about the world we live in. They shouldn't be burdened with content-free dogma like Intelligent Design." The AAS joins many other scientific and educational organizations, including the National Academies of Sciences, National Science Teachers Association, AGI, and American Geophysical Union, in supporting evolution in science education. The statement is available at http://www.aas.org/.

From the *Federal Register*

Below is a summary of F*ederal Register* announcements regarding federal regulations, agency meetings and other notices of interest to the geosciences community. The *Federal Register* is available online at http://www.access.gpo.gov/su_docs/fedreg/frcont05.html.

DOE/BLM: The Department of Energy and the Bureau of Land Management have posted a notice informing the public of a proposed action on western federal lands. The Energy Policy Act of 2005 directs the Secretaries of Agriculture, Commerce, Defense, Energy and the Interior to designate corridors on federal land for oil, gas and hydrogen pipelines and electricity transmission and distribution facilities. The agencies intend to prepare an environmental impact statement (EIS) for this action and will conduct 11 public scoping meetings and solicit public comments for consideration in establishing the scope and content of the EIS. [*Federal Register*: September 28, 2005 (Volume 70, Number 187)].

MMS: The Minerals Management Service published a final rule to provide immediate temporary relief to the oil and gas industry in the aftermath of Hurricanes Katrina and Rita that provides an extension to pay royalties owed on federal oil and gas leases and reports corresponding royalty and production documents. Extending the due date for royalty payments means that late payment interest will not accrue for the period between the original due date and the new due date established by this rule. [*Federal Register*: September 29, 2005 (Volume 70, Number 188)].

The Minerals Management Service is delaying until January 1, 2006, the effective date of a rule that will implement fees to offset the costs of providing certain services related to its mineral programs. This delay is necessary because of damage caused in the New Orleans area by Hurricane Katrina and subsequent flooding. The delay will provide relief to the government and the oil and gas industry as they recover from this disaster. [*Federal Register*: September 26, 2005 (Volume 70, Number 185)].

NSF: The National Science Foundation announces its intent to prepare an Environmental Impact Statement to evaluate the potential environmental impacts associated with the use of seismic sources in support of NSF-funded research by U.S. academic scientists. NSF requests public participation in the scoping process. A list of meeting dates and locations is available on the *Federal Register*. For more information contact Alexander Shor (OCE-EIS@nsf.gov). [*Federal Register*: September 22, 2005 (Volume 70, Number 183)]. ■

HGS Financial Summary for 2004 – 2005

*by **Ken Nemeth,** Treasurer*

Fiscal Year 2004 – 2005 was not a financial success for your society. Cash flow requirements, overhead needs, and increased costs resulted in an operating loss for the year. Net income was down from previous years as *Bulletin* expenses rose, trailing expenses were larger than expected, and we did not host the Africa Symposium. The decrease in income forced the Board to withdraw money from the investment account to cover cash flow needs at the end of the previous fiscal year and at the start of the 2004–05 fiscal year. Income booked to the 2004–05 fiscal year was approximately $586,000 with expenses of roughly $634,000 resulting in a net loss of $48,000. Trailing expenses of approximately $20,500 impacted cash flow early in the fiscal year.

The Society's "big ticket" items are the *Bulletin*, office and web expenses, meetings and entertainment events. *Bulletin* expenses outstripped income and were our biggest expense after office and website overhead.

Meeting income dropped slightly from previous years. The income decline due to lower attendance was slightly offset by increased charges in response to higher lunch costs at the Petroleum Club.

Entertainment gross income was nearly flat compared with the previous year, but net income was down due to a 19% increase in expenses. The Shrimp Peel continues to be our most successful entertainment event, netting $5500 after the fiscal-year split with co-sponsor GSH. We are in the process of settling the Saltwater Tournament results with the GSH.

Office expenses decreased slightly from the previous year. This was due primarily to not using additional secretarial staff during the year. The biggest portion of joint expenses is payroll for the office staff and web master. Office income results primarily from GSH reimbursement for joint office expenses. One quarter of this income is usually attributable to the previous fiscal year.

This was the last year for income from APPEX. We will be receiving income from two NAPE events in future years. HGS will host the 2005 Africa Symposium, so we will see an increase in income attributable to that event. In 2006 we should receive income from the AAPG national convention to be held in Houston.

The investment account has met the goals established by the 2003–2004 Board. We have maintained principal with modest risk. If not for the cash flow requirements during the first half of the fiscal year we would have seen an overall increase in the account value.

Stronger expense monitoring, staff reorganization/reductions, symposiums, increased continuing education offerings, national meetings and new publication sales should result in a significant financial improvement in 2005–2006. ■

HGS Financial Summary *continued on page 50*

HGS Financial Summary for 2004–2005

continued from page 49

HGS Preliminary 2004-2005 Profit & Loss

	INCOME	EXPENSE	PROFIT/LOSS	COMMENTS
ASSOCIATED SOCIETIES	$ 6,131	$ 1,625	$ 4,506	Includes Exhibit Expenses
ACADEMIC LIASON	$ -	$ 619	$ (619)	
BALLOT EXP	$ -	$ 1,288	$ (1,288)	
BANK INCOME	$ 4,280	$ 1,748	$ 2,532	
BOARD	$ -	$ 2,254	$ (2,254)	
BULLETIN	$ 145,644	$ 170,642	$(24,998)	
WEB SITE	$ 6,819	$ 8,969	$ (2,150)	
CONTINUING EDUCATION	$ 17,717	$ 7,247	$ 10,470	
DIRECTORY	$ -	$ 162	$ (162)	
DONATION	$ 10,670	$ 14,743	$ (4,073)	
DUES/MEMBERSHIP	$ 79,288	$ 2,050	$ 77,238	Member Renewals Declined
EARTH SCIENCE WEEK	$ 3,666	$ 2,804	$ 862	
ENTERTAIN	$ 129,709	$ 117,839	$ 11,870	
EXPLORER SCOUTS	$ -	$ 151	$ (151)	
FIELD TRIP	$ -	$ -	$ -	
FINANCE	$ -	$ 375	$ (375)	
INVESTMENTS	$ 15,469	$ 4,776	$ 10,693	CD and Bond Interest
MEETING	$ 101,792	$ 81,659	$ 20,133	
MISCELLANEOUS	$ 1,000	$ 222	$ 778	
NOMINATE	$ -	$ 49	$ (49)	
OFFICE	$ 60,260	$ 202,126	$(141,866)	GSH Income; Salaries, Office Expenses
PRESIDENTIAL/AWARDS	$ -	$ 12,343	$(12,343)	
PUBLICATIONS	$ 3,737	$ -	$ 3,737	New and Sales
TREASURER	$ -	$ 200	$ (200)	
TOTALS	**$586,182**	**$633,891**	**$(47,709)**	**Net Loss**

ENTERTAIN	INCOME	EXPENSE	PROFIT/LOSS
Saltwater Tourn	$ 25	$ (200)	$ (175)
Golf	$ 54,870	$(55,145)	$ (275)
Guest Night	$ 23,540	$(19,579)	$ 3,961
Shrimp	$ 22,231	$(14,611)	$ 7,619
Skeet	$ 12,337	$ (9,819)	$ 2,518
Tennis	$ 5,850	$ (4,727)	$ 1,123
Scholarship Dance	$ 10,856	$(13,758)	$ (2,902)
TOTAL ENTERTAIN	**$129,709**	**$(117,839)**	**$ 11,870**

Application to Become a Member of the Houston Geological Society

Qualifications for Active Membership

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

Qualifications for Associate Membership (including students)

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

Annual Dues Expire Each June 30.

Annual dues are $24.00; full-time students and emeritus members pay $12.00.

Mail this application and payment to:

Houston Geological Society
10575 Katy Freeway, Suite 290
Houston, TX 77024
Telephone: 713-463-9476 Fax: 713-463-9160

Payment method:

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

Card # _____ Expiration Date: _____

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

Name: _____
Address: _____

_____

Home Phone: _____ *Spouse's Name:* _____
Email: _____
Job Title: _____
Company: _____
Company Address: _____

_____

Work Phone: _____ *Fax Number:* _____
Circle Preferred Mailing Address: Home Office
Professional Affiliations:
❑ Active AAPG Others: _____

Professional Interest:
❑ Environmental Geology
❑ International E&P
❑ North American E&P (other than Gulf Coast)
❑ Gulf Coast E&P (onshore & offshore)

Membership Directory Preference
❑ CD Rom
❑ Printed

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

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

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

Earth Science Work Experience _____

_____

_____

Applicant's Signature _____ *Date* _____

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

Name: _____

Signature _____ *Date* _____

Membership Chairman _____ *HGS Secretary* _____

rev. 5/5/2003

HGA *and* GeoWives **News**

HGA

The holiday season is in full swing as the Houston Geological Auxiliary is preparing for its annual Christmas Luncheon. Marti Lund and her able cochair, Mary Kae Dingler, set the standard for our socials this year with their outstanding luncheon and program by Jan Hargrave at Maggiano's Little Italy in September. And what a standard they set! Many compliments have been extended ("This was the best luncheon and program we have had in a long time") and the challenge is noted for the future functions.

Some very special guests attended the luncheon at Maggiano's and the HGA was delighted they did. Very serious negotiations, concerning a merger between the Auxiliary to the Houston Association of Petroleum Landmen, the Houston Geophysical Auxiliary and Houston Geological Auxiliary, are beginning. These groups are investigating the merits and logistics of a merger between the three groups. We are all married to petroleum/gas experts thus are studying the feasibility of this idea. Many of our sister auxiliaries in other cities have already effectively accomplished this merger. Mickey Murrell, the President of Petroleum Landmen's Auxiliary, was in attendance as were several other members from these groups.

Betty Alfred, Chairman of the HGA Christmas Luncheon, to be held at the BraeBurn Country Club on Friday, December 16, will meet the challenge of excellence extended by the first luncheon. The program Take Five is a talented, upbeat group that no one will want to miss. Our very own Pat Austin leads this group, which will treat us with upbeat Christmas music. What a treat this will be. The challenge will be met!

The HGA has a special committee, chaired by Edie Frick, for those who don't drive and need to be provided transportation to our luncheon.

A HGA membership application is printed in the HGS *Bulletin* and all wives of HGS members, as well as all female geologists, are encouraged to join. The socials are outstanding, the camaraderie stimulating and the opportunity to assist the HGS on occasions is fulfilling. ■

by ***Winona LaBrant Smith,*** *HGA First Vice President*

GeoWives

The GeoWives have an interesting calendar planned for 2006. We are looking forward to all the exciting and fun programs that Sara Nan Grubb, our first Vice President, has planned for us.

On Thursday, January 26, the GeoWives will visit the Diana Princess of Wales Exhibit at the Museum of Natural Science, #1 Herman Park Drive, at 10:30 a.m. We will meet at Memorial Drive Presbyterian Church at 9:45 to organize carpools and travel to the museum together. The total cost is only $15.00 including lunch, so send your check no later than January 18 to Dene Grove, 12715 Pebblebrook Drive, 77024, for a reservation or call 713-467-3905 for more information.

From the museum we will go to Anne Rogers's home at 200 Holcombe Blvd. to enjoy a catered luncheon at 12:30 and a view of Houston from her beautiful high-rise home. Following lunch we will have a short business meeting and visitation with fellow members and guests. It is necessary to carpool because parking is limited. If you must drive, call Ann Rogers for information on parking.

We will look forward to seeing members and guests on January 26 for a fun-filled day.

See page 44 for the GeoWives Application.

by Dene Grove, *GeoWives President*

You are invited to become a member of
Houston Geological Auxiliary
2005–2006 dues are $20.00

make check payable to *Houston Geological Auxiliary* and mail to: Norma Jean Jones • 14302 Appletree • Houston, Texas 77079

HGA YEARBOOK INFORMATION

Last Name	First Name	Name Tag
Spouse Name	Name Tag	HGS Members Company
Home Phone ( )	Business Phone ( )	Business Fax ( )
Street Address	City	Zip
Birthday, Month, Day ONLY	Email Address	Home Fax ( )

HGS Website Committee Needs You!

As the new HGS Website Committee Chair, I am looking for members to join the Website Committee.

The HGS Website, along with the *Bulletin*, is our organization's window on the world. Our Website is among the most active is recognized as one of the leading resources in the worldwide geological community. Because the HGS is the largest local geological society in the world, that should not be a surprise. It is, however, a challenge to maintain the excellence established since the founding of the Website in 1997 by Bill Osten and later, Dave Crane.

That's why I am asking inventive, dedicated HGS members to volunteer and join Webmaster Lilly Hargrave and me as we follow the very high standards set by previous Website Chair Bill Osten and Webmaster Dave Crane.

Please call me today to join the Website Committee: 713-557-9076 or send me an e-mail at aberman@houston.rr.com! ■

Art Berman
HGS Website Committee Chair

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13	Maps, Positions & Grids	Houston, TX
14-15	Quick Look Techniques From Prospect Evaluation to Reserves Estimation	Houston, TX
19-23	Seismic Fundamentals for Exploration and Development	Houston, TX
29-30	Logbust™ Computer Application of Multiple Bischke Plot Analysis (Seismic and Well Log Correlation Validation/Growth Analysis)	Houston, TX
October, 2005		
3-7	Applied Subsurface Geological Mapping	New Orleans, LA
13-14	AVO, Rock Physics and Inversion	Houston, TX
24-28	Development Geophysics	Houston, TX
24-28	Hydrocarbon Exploration in Extensional Systems	Houston, TX
31-11/04	Basin Analysis and Hydrocarbon Potential	Houston, TX
November, 2005		
7-11	Sequence Stratigraphy in Exploration and Production Geology	Houston, TX
14-18	Integration of Log and Seismic Data for Exploration, Exploitation and Production	Houston, TX

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