



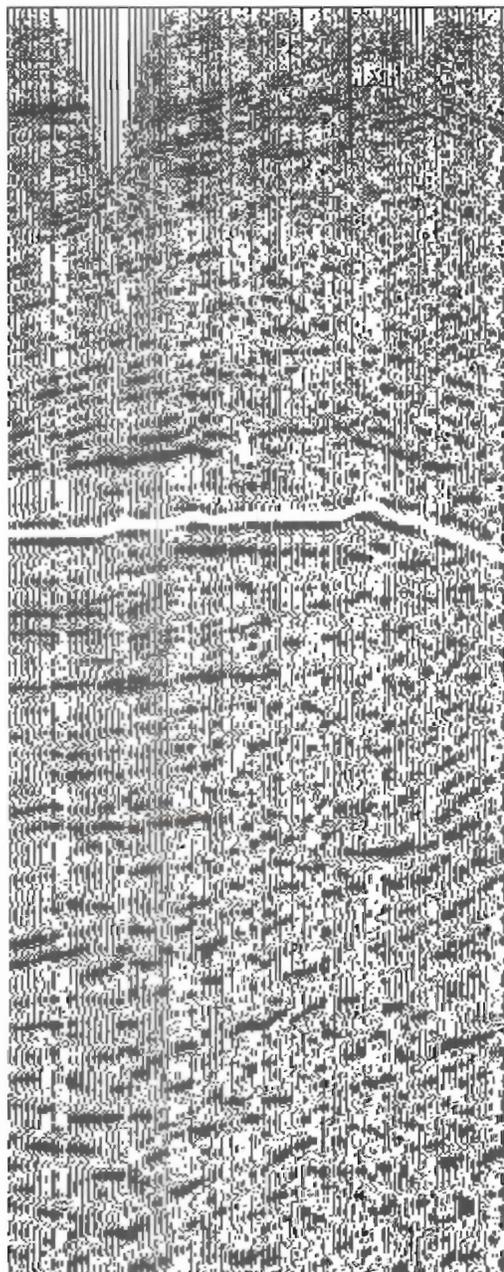
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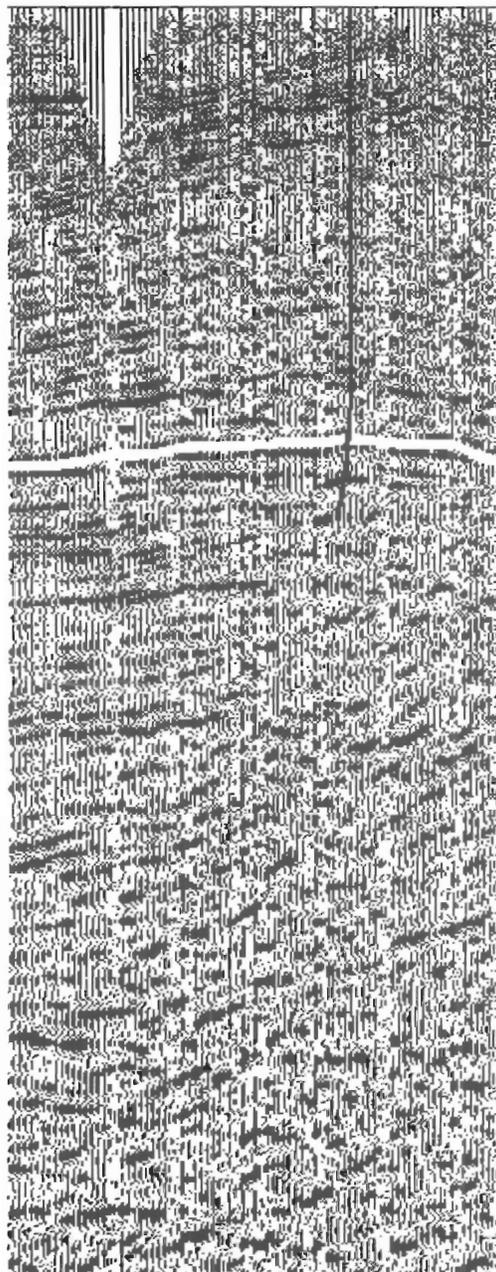
January 1996

Volume 38, Number 5

Migration While Drilling



Pre-spud



At TD

In This Issue

- Interaction of Sediment and Salt, GOM
- Building Environmental Consensus
- Growth of an Independent Through Exploration
- Drilling and Real Time Migration

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Contents

Letter from the President	5	<i>Ron Nelson</i>
Letter from the Editor	7	<i>Gail Bergan</i>

Meetings

HGS Dinner Meeting	8	Regional Offshore Interaction of Sediment and Salt, Gulf of Mexico, <i>James F. Fox</i>
Environmental/Engineering Dinner Meeting	9	Building Environmental Consensus, <i>John D. Wilson</i>
North American Explorationists Dinner Meeting	10	Barrett Resources Corporation: Growth of an Independent Through Exploration, <i>William J. Barrett</i>
HGS Luncheon Meeting	11	DREAM™—Drilling and Real Time Migration: A New Method for the Geophysical Monitoring of Wells, <i>Luca Bertelli, Luca Savini, and Luca Aleotti</i>

Columns

Sequence Stratigraphy	12	Sequence Stratigraphy at the 1995 GCAGS Convention, <i>Bill Devlin</i>
-----------------------	----	--

Committee News

Government Affairs	16	Legislative Update, <i>Deborah K. Sacrey</i>
Awards Committee	18	Seeking Nominations, <i>Dan Bonnet</i>
	21	Calendar of Events
Executive Board	22	HGS Board Divvies Up AAPG Profits, <i>James A. Ragsdale</i>
HGS Short Course	26	Applications, Design, and Interpretation of 3-D Seismic on the PC
	30	HGS Luncheon Price to Increase, <i>Ann Martin</i>
Our Roving Reporter	35	The Global Energy Industry in the 21st Century, <i>Victor A. Schmidt</i>

ON THE COVER

In Italy's Po Valley, new seismic velocities obtained using the noise generated by the drill bit enabled reprocessing of this line during the drilling of this wildcat well. The operator changed the well plan and deviated the hole as a result of the remigration. This new technology will be discussed at the January 24 HGS Luncheon Meeting (see page 11).

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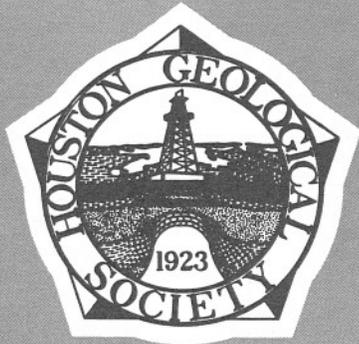
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January 1996

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To Submit Articles and Announcements

Manuscripts, inquiries, or suggestions should be directed to the Editor, *HGS Bulletin* c/o the HGS office on Harwin.

The deadline for copy is six weeks prior to the month of publication, on the 15th of each month. All submissions arriving by the deadline and in digital format will be given priority for *Bulletin* space.

All copy must be prepared on a word processor and submitted on disk, along with an identical hard copy of the text. The *Bulletin* is produced on a Macintosh using Pagemaker 5.0 software. Most word processing programs, including those on a PC platform, should be compatible with our software. Please call the Editor with any specific questions.

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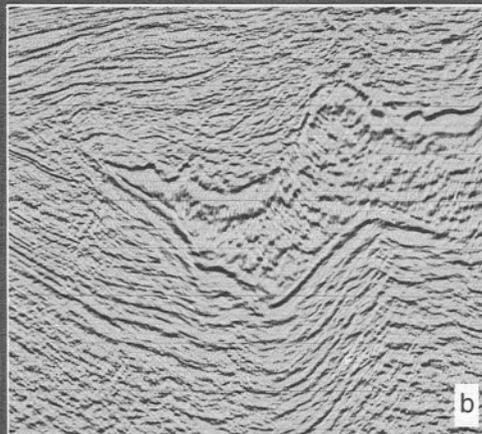
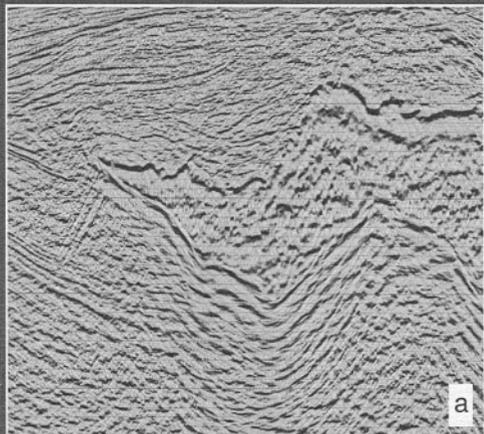
Members can call the above number to listen to a description of job opportunities from employers seeking geologists of all disciplines. Tailor your resume to emphasize how your background matches their needs; then the Personnel Placement Committee will pass it along directly.

The hotline is updated at least weekly, so call often.

The Houston Geological Society Bulletin (ISSN 0018-6686) is published monthly except July and August by the Houston Geological Society, 7171 Harwin, Suite 314, Houston, Texas 77036. Subscription to the Houston Geological Society Bulletin is included in the membership dues (\$18.00 annually). Subscription price for non-members within the contiguous U.S. is \$25.00 per year. For those outside the contiguous U.S. the subscription price is \$46.00 per year. Single-copy price is \$3.00. Second class postage paid in Houston, Texas.

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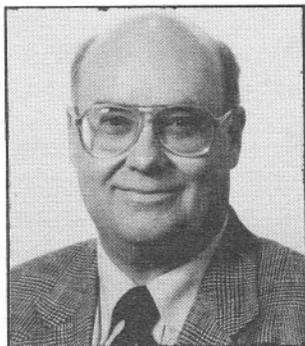
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Letter from the President



HGS has an Important Role in the GCAGS

A couple of weeks ago I attended the Gulf Coast Association of Geological Societies (GCAGS) Annual Convention in Baton Rouge. As HGS President, I represent our members on the Board of Directors of this largest AAPG section. I would like to take this opportunity to update you on the status and activities of the Section.

The Baton Rouge Convention was a success, with over 855 in attendance and a healthy profit returned to the GCAGS and the host Baton Rouge Geological Society. While attendance was not large compared to other years, hard work by and close

cooperation between the Baton Rouge Convention Committee, chaired by Dave Pope, and the GCAGS Convention Committee, chaired by HGS member Dan Smith, proved that good planning and budget preparation can ensure that even the smaller conventions can be positive experiences, both technically and financially. Results like these over the last several years have encouraged the Board to retain the current eight-city rotation for the GCAGS Convention. Continued diligence by Dan Smith and his committeemen like Larry Bartell, a current HGS Executive Board Member, will allow the smaller Societies within the GCAGS to remain on the schedule in the future.

The GCAGS itself is in good financial shape, with roughly \$460,000 in cash reserves while sponsoring a \$250,000 to \$300,000 convention budget each year. New initiatives this year included recommendations by Long-Range Planning Committee Chairman John Amoruso, an HGS member and Past-President, on publishing the Transactions of the Conventions in digital format to facilitate hard-copy publishing, selling copies to non-attendees in digital format for profit, and establishing a Publicity or Marketing Committee to get the word out on the quality of the Sections activities. Board members are

proud of the more focused, practical, and intimate scale of these meetings compared to larger national meetings and want to let others know of the niche our Sectional Meetings fill.

We in the HGS have long played an important and active role in the GCAGS. It behooves us as members of the largest affiliate society to help ensure the success of our GCAGS Meetings, especially when held in the smaller of our sister society cities.

On a final note, it was pointed out that Louisiana has initiated plans for a core repository to be built in Baton Rouge. They will be seeking cores, logs, and maps covering onshore and offshore Louisiana. If you know of materials that are in danger of being discarded because of deaths or company bankruptcy, please recommend they be sent to the new repository. Information on the new repository can be obtained from Bill Marsalis, 1995 GCAGS President in Baton Rouge. ■



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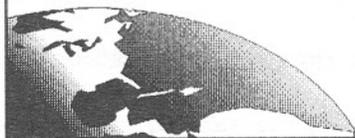
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Letter from the Editor

Rants and Raves

This issue marks the halfway point in my term as Editor. I thought surely by now I would have a plethora of "Letters to the Editor" to print, along with some sassy responses from me. However, except for a few pithy e-mail messages, I'm surprised to report that I have not received a single Letter to the Editor. What I *have* received is an abundance of verbal comments about this or that in the *Bulletin*.

I decided that what I would do this month is give you a behind-the-scenes look at my first five months as Editor—you know, give you a "feel" for the job. What better way to do that than to reprint many of those comments and e-mail messages? Don't worry, I won't disclose anyone's identity—but trust me, I'm not making any of this up! If any of you have ever wondered what it's like to be the volunteer Editor of a sizable monthly publication, read on:

"Gail, I know it's the 20th and the deadline was the 15th, but I've been delayed because of [fill in the blank]. If I get this to you in the next couple of days, will you still accept it for the next issue?"

"Is there any way we can run a full page ad for the [HGS event] for four months, have the cover photo, and an article to boot? We expect 30–40 people for this thing."

"Why can't I just fax this [article, abstract, event announcement] to you? I don't [have time, know how, want] to put it on a disk."

>Congratulations on your first issue.
>Are you so thrilled that you want to be editor two years in a row?

>It never ceases to amaze me how each >successive new HGS *Bulletin* Editor >manages to top the last one with new >innovative upgrades to our wonderful >*Bulletin* . . . I tore into it the moment that it arrived!!

"I have a [modem, computer] but I don't know how to use it. Can you walk me through it?"

"Hey Gail, I don't like the way you've laid out the Calendar page this year—I find calendars that start with Monday too confusing."

"I really like the way you've started the Calendar page with Monday—my week starts on Monday, not Sunday."

"Several ads are messed up in the proof copy. A few are missing, and one that shouldn't be in there is in again."

"Gail. Bad news. The layout person at the printer quit."

"I don't understand why you didn't print my announcement exactly the way I sent it in. I had all the headings, text, and little pictures all taped in place and ready to go."

"We shouldn't have so many reprints in the *Bulletin*. The HGS is large enough that we should be able to generate the *Bulletin* from within. Other societies should be reprinting our articles."

"I really like having technical articles reprinted in the *Bulletin*. See what you can find."

"Gail, did you look at your proof copy of the *Bulletin* yet? The printer's filter didn't pick up any of the symbols for some reason—all the apostrophes, dashes, trademark symbols, and quotation marks are missing. We'll have to go through it with a fine-tooth comb before it goes to press."

>You're doing a great job with the *Bulletin*. You have me in awe. (Perhaps I >should have put the last sentence all >in CAPS!!!!)

"What do you mean by 'digital file'?"

"The size of the *Bulletin* is totally out of control. We are spending way beyond our needs, and should go back to a simple newsletter."

"I like a nice, big, fat *Bulletin*. It's a major factor in drawing new members to the Society, and I'm always proud to flash it around at conventions."

"It says here the deadline is the 15th. What's the *real* deadline?"

"Gail, big problems while you were gone on vacation. The printer couldn't read any of the files you dropped off before you left, and we had to OCR-scan all the articles in from the hard copy. Did you have a good time in Hawaii?"

>The *Bulletin* is looking great! I didn't >find your October letter from the editor >boring at all—very professional . . .

"What do you mean, I have to cut my four-page abstract down to 500 words?"

"I've never read anything so boring in my life as [fill in the blank]."

>I don't get it—a copy of a Post >Office form signed by Margaret? >Ho Hum . . . isn't there some geological-type news out there???

"Thanks for your efforts as the HGS Editor. You couldn't pay me enough money to do that job." ■



Gail Bergan
gbergan@ix.netcom.com

HGS Dinner Meeting, January 8, 1996

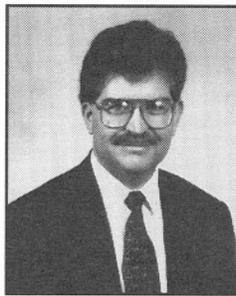
Regional Offshore Interaction of Sediment and Salt, Gulf of Mexico

By James F. Fox, Phillips Petroleum Company

The Gulf of Mexico is a dynamic basin dominated by prograding sediment wedges and strong salt tectonics. These two powerful geological forces have combined to form one of the most complex and hydrocarbon-rich basins in the world. As geoscientists, we are asked to make sense of this complex system, and continue to find economically attractive well locations. The enormity of the database makes the nature of our work different from exploring in a virgin basin. Integrating all we know and applying it to new areas require a set of rules on how sediment and salt interact. These rules are what allows some companies to achieve impressive successes in the technically demanding deep-water and subsalt trends.

The basin separates into depotroughs that collect the sediment, and each of these depotroughs is controlled by the balance between subsidence, progradation, salt movement, fault movement, and other factors. By examining the spatial relationships between different depotrough types and their main structural controls, it is possible to reconstruct the historical interaction between different dominant salt styles and episodes of deposition. From this observation, we can surmise that dominant structural styles varied through the Tertiary in

the Gulf of Mexico, and this variation is probably related to the changes in relative sea level and the rate of sedimentation and subsidence. If we can establish rules for these relationships, a powerful model can be built that can be used in prospecting for future hydrocarbon fields in this province. ■



James F. Fox is the Subsalt Exploration Director for Phillips Petroleum Company in Houston. In this capacity, he determines the strategic direction and

oversees the technical work of a group of geoscientists pursuing the subsalt play offshore Louisiana. Previous to this position, Mr. Fox served as the Geoscience Director for Worldwide Exploration. He has worked for Phillips for 17 years, working in Latin America, the UK, and North America exploration and development groups.

Mr. Fox teaches a continuing education seminar for AAPG called "Interaction Between Sedimentation and Salt Tectonics," presenting the topic to more than five hundred geoscientists during the last three years. In addition, he has presented numerous talks on the subsalt play at the OTC, professional conventions, investment meetings, and the United States Congress.

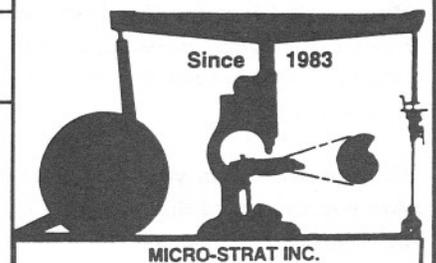
Poster Session

Salt Tectonics and Depositional Architecture of the Continental Slope, Northeastern Gulf of Mexico

By Cindy Yeilding and Chris Travis, British Petroleum, Houston

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HGS Environmental/Engineering Dinner Meeting, January 10, 1996

Building Environmental Consensus

By John D. Wilson

The purpose of the Houston Advance Research Center's (HARC) Center for Global Studies is to conduct research on and to increase public awareness of global issues such as population growth, resource management, environmental protection, and sustainable development. The Center is involved in three efforts to build environmental consensus.

The *Global Commons* project is a program of the National Academy of Sciences (NAS) in partnership with HARC. NAS will identify a research agenda on sustainable development practices. HARC will reach out to help business leaders and environmental non-governmental organizations (NGOs) bring their interests to the project.

Sustainable Development Initiative for the Rio Grande/Rio Bravo Basin—A 1994 basin-wide conference promoted dialogue about concerns in this bi-national river basin. Dia del Rio 1995 was a basin-wide celebration and occasion for educational and volunteer projects.

Houston Environmental Foresight—a comparative assessment of environmental risks in the larger Houston area. Foresight's goal is to enhance the role of scientific expertise and community values in environmental decision making. ■

John D. Wilson is a research associate at the Center for Global Studies at the Houston Advanced Research Center. Mr. Wilson holds an M.S. degree in Public

Policy from the John F. Kennedy School of Government at Harvard University and a B.S. degree from Rice University, majoring in Physics and History. Mr. Wilson has worked on environmental topics from a number of different perspectives, including research on global climate change to various issues in negotiation and consensus-building. He is presently the project manager for Houston Environmental Foresight.



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HGS North American Explorationists Dinner Meeting, January 22, 1996

Barrett Resources Corporation: Growth of an Independent Through Exploration

By William J. Barrett, Barrett Resources

Barrett is an independent natural gas and oil exploration and production company. Barrett uses its own exploration staff to develop a geologic concept into an exploration prospect, which is drilled either solely by Barrett or with partners. Barrett also operates gas gathering systems and a gas processing plant in the areas that are synergistic to the Company's production. Barrett has a gas marketing and trading subsidiary, which allows the Company to market the Company's own natural gas production and to purchase and resale of other companies' natural gas. Barrett is headquartered in Denver, Colorado, and its common stock is traded on the New York Stock Exchange under the symbol BRR.

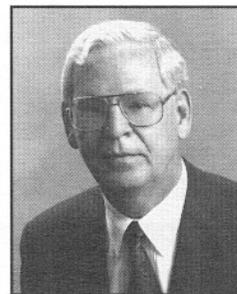
Barrett's key areas of operation and focus are in the Rocky Mountain and Mid-Continent regions. Barrett's areas of greatest reserves are in Kansas, Colorado, Oklahoma, and Wyoming. The greatest concentration of wells is located in the Piceance Basin in northwestern Colorado, the Arkoma and Anadarko Basins in Oklahoma and Kansas, and the Wind River and Greater Green River Basins in Wyoming. Two areas have played key roles in Barrett's past growth and are expected to play equally key roles in Barrett's future growth. The areas are very different geologically, but have one thing in common, their very large potential. These two areas are the Grand Valley-Parachute-Rulison Gas Fields located in the Piceance Basin of Colorado and the recently discovered prolific Cave Gulch Gas Field located in the Wind River Basin of Wyoming. The following two paragraphs give synopses of these two areas and will be the focus of our presentation.

Piceance Basin Summary. The Piceance Basin of Northwestern Colorado is one of Barrett's core areas with long-life program gas reserves totaling over 386 bcf gross. Future reserve growth is expected to increase the ultimate recovery from the area to over 1 trillion cubic feet of gas. The

Company drilled its first Piceance well in 1984 and currently owns or has a working interest in 286 gross wells in the Basin. Barrett operates 263 of these wells. The Company's activities in the Piceance Basin are conducted primarily in the Grand Valley, Parachute, and Rulison Fields. The Company is currently producing a gross 80 mmcf/d from this area. Current drilling activities primarily target the tight fluvial sandstones of the Williams Fork Formation of the Mesaverde Group. The Williams Fork formation, ranging in thickness from 2,900 to 3,700 feet, is composed of interbedded mudstones, siltstones, and sandstones with a section of abundant interbedded coals at its base. The sandstones are characterized as being heterogeneous, discontinuous, highly compartmentalized, and limited in areal extent. In Barrett's area of operation, the Williams Fork contains from 1,700 to 2,400 feet of gas-saturated section. A given wellbore will penetrate between 30 and 50 of these tight gas-bearing sand bodies that average less than 20 acres in size. Natural fracturing is pervasive throughout the sands and is instrumental in obtaining commercial production. However, even with these natural fractures, massive hydraulic stimulation is still necessary to yield commercial production. An average Mesaverde gas well is expected to produce 1.5 bcf of gas in Grand Valley and Parachute Fields and 1.8 bcf of gas in Rulison Field during the first 20 years of its life. Many of the wells will exceed these amounts, producing 2 to 3 bcf of gas. The average production life of these Mesaverde wells is expected to exceed 50 years.

Cave Gulch Summary. Cave Gulch Field is a faulted anticlinal feature with over 1,200 feet of closure in the footwall of the northwest-southeast trending Casper Arch Thrust along the northeast terminus of the Wind River Basin, Wyoming. Cave Gulch is a pressure depletion reservoir that produces out of gas-charged fluvial, lenticular sands of the Upper Cretaceous

Meeteetse, Lance, and Tertiary (Paleocene) Ft. Union Formations. A typical well, drilled to 9,200 feet, has a combined net pay thickness in excess of 1,800 feet with density (2.65) porosities ranging from 12% to 26% and deep resistivities averaging about 100 ohm-m. Although no single well has been completed in all zones, current daily rates range from 3,500 mcf/gpd to 25,000 mcf/gpd on a per well basis; several of the wells have flat decline rates. Nominally, the Company expects to realize approximately 10 to 15 bcf/g per 40-acre locations from the wells located on the high part of the structure. Proved reserves are currently estimated at approximately 150 bcf in the Lance and Ft. Union Formations, but could ultimately be much higher. Barrett Resources acquired a proprietary 3-D seismic survey in early 1995 to corroborate additional development locations in the shallower pay horizons as well as to help substantiate deeper potential in the lower Mesozoic and Paleozoic sections. Since August of 1994, Barrett has drilled eight wells, completed seven, and is currently drilling two development wells. ■



William J. Barrett has been Chief Executive Officer since December 1983 and chairman of the Board of Directors since March 1994. He was President of the company from

December 1983 through September 1994. He has also been a director of Barrett Fuels Corporation since its formation in September 1990. Mr. Barrett's previous experience includes serving as Vice-President of Exploration and Director of Rainbow Resources, Inc., President and Director of B&C Exploration, and Chief Geologist for Inexco Oil Company.

HGS Luncheon Meeting, January 24, 1996

DREAM™—Drilling and Real Time Migration: A New Method for the Geophysical Monitoring of Wells

By Luca Bertelli, Luca Savini*, and Luca Aleotti, Agip S.p.a., Milan, Italy

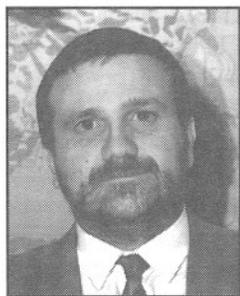
Interpreted seismic sections and derived maps in time and/or depth are normally used to locate wells. The same data are subsequently modified and reinterpreted on the basis of final well results. In the drilling phase, there is a sort of blackout in the use of geophysical information. The "migration while drilling continuously" (MWDC) method is a new approach to the while-drilling geophysical monitoring of a well. The approach makes it possible to answer two basic questions: Where is the bit in relation to the seismic section? Is the geological prognosis coherent with the while-drilling information?

Starting from a depth reference section obtained with an initial velocity field, the method allows the operator to continuously update the velocity field while drilling, and thus to refine the depth model and iterate the depth migration. The seismic velocities obtained by recording systems (i.e., Seisbit, or Tomex), which exploit the noise generated by the bit as a source of acoustic energy, are the most suitable to integrate

well and migration velocities. Other velocities may also be derived from logging-while-drilling (LWD) measurements. One of the main advantages of seismic-while-drilling (SWD) tools compared to the other possible sources of data is the capability of prediction "ahead of the bit." As the original depth seismic image is continually updated, integrating the new well velocity information on the initial model, the seismic image becomes more and more reliable. With this more reliable image, important decisions can be made, such as redefining the well program, picking casing points, predicting over-pressured zones, etc.

Agip and Western Atlas are developing a new product that combines MWDC principles and software from Western Atlas. The software package (DREAM™) is structured into four main modules: a project database, a while-drilling info package (Well Data Analysis), a modeling module, and the depth-processing package. The prototype actually handles 2-D seismic

data, but extensions to 3-D data sets are presently being developed. The core of the DREAM™ package is the integration between surface velocity data (geophysical time domain) and well velocity data (geological depth domain) that have a different physical meaning and, therefore, may vary a great deal. Those velocity functions are processed by an interactive module (Well Data Analysis) that calculates, using linear and non-linear regression techniques, the new velocity profile. This new velocity information is added to the flow of operations so that the initial velocity model can be changed laterally and vertically using also the section's structural information. The resulting model makes it possible to obtain a new depth (and time) seismic image using migration or conversion algorithms. Both MWDC principle and DREAM™ prototypes have been practically applied on synthetic data sets and real cases. Examples will be shown concerning an exploration well located in the Po River plain. ■



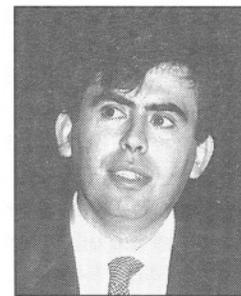
Luca Aleotti graduated in Geological Sciences from the University of Milan in 1983, and joined Agip in 1984 in the Seismic Data Processing Department.

Since 1986, he has gained considerable experience in the field of well seismic acquisition, processing, and interpretation. He became technical leader for well seismic operations in the Seismic Stratigraphic Methodologies Department in 1993, and was in charge of the R&D activities for Seisbit and Cross-hole Seismic projects. Presently, as technical leader, he is in charge of an exploration project for the New Ventures Department.



Luca Bertelli graduated in Geological Sciences from the University of Florence in 1983, and was employed by Agip in 1984 in the Seismic Data Processing

Department. In 1987, he was technical leader for 3-D acquisition and processing activities. In 1989, he was appointed Project Manager of seismic operations, and in 1992 he was appointed Manager of Multidisciplinary Scientific Research Projects for Exploration. Presently he is in charge of the Seismic Stratigraphic Methodologies Department and well seismic operations.



Luca Savini graduated in Geological Sciences from the University of Ferrara in 1986. He joined Agip in 1987, gaining professional experience in the Geophysical

Research Department. Since 1989, he was in charge of the field planning group for 2-D and 3-D seismic. In 1995, he was assigned as technical leader for well seismic operations in the Seismic Stratigraphic Methodologies Department. Presently he is in charge of the Seisbit/Dream project.

*speaker

MWDC®—Agip patent

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Sequence Stratigraphy: Applications and Perspectives

Sequence Stratigraphy at the 1995 GCAGS Annual Meeting

By Bill Devlin, Exxon Ventures, CIS

Several papers on sequence stratigraphy were presented at the 1995 GCAGS meeting this past October in Baton Rouge, Louisiana. For those who did not attend the meeting (myself included), I comment on a few of the papers concerning offshore and onshore Gulf of Mexico topics that should be of some interest to HGS members. This is not meant to be a complete summary of all sequence stratigraphy-related papers presented at the meeting. Those interested in more detail should refer to the 1995 GCAGS Transactions of the 45th Annual Convention.

Two papers presented the sequence stratigraphy of Plio-Pleistocene strata from the northeastern and northwestern parts of the Green Canyon area (Budhijanto and Weimer, and Navarro and Weimer, respectively). Both of these papers are products of the University of Colorado Gulf of Mexico Research Consortium, and describe integrated sequence stratigraphic interpretations of siliciclastic turbidite deposits that were deposited during active salt movements. 2-D seismic, wireline logs (tied to seismic), and biostratigraphic data were used. The only thing apparently missing from a completely integrated study was core data, although some of the tables indicate that at least some lithology information was available. Basic sequence stratigraphic and sedimentological interpretations are presented based on sound seismic stratigraphic techniques and a relatively substantial amount of data (for academia, that is). Some of the oil fields in these areas include Teak, Lobster, Bison, Allegheny, and Mahogany.

Given the space limitations of the GCAGS Transactions volume, the short papers are necessarily only basic summaries. In each study several sequences were identified, but only one is described as being representative of the area. The figures presented are clear and readable. The seismic has reproduced well to show the data and interpretation. The logs presented are somewhat too compressed to discern

any detail, but the gross features of the stratigraphy can be seen. Both papers present useful tables that summarize observed seismic facies and their correlation to gamma ray log patterns, lithology, and geologic interpretation.

Another integrated sequence stratigraphic study was presented from the eastern offshore Mississippi Delta region (Sunwoo, et al.), an area including parts of the Mobile, Viosca Knoll, and Main Pass OCS areas. This area was chosen by the authors because of good seismic data quality, owing to the fact that there is little deformation in the area from mobile salt, overpressured shale, and faulting.

As in the other two papers mentioned above, I like this study because it is based on a sound, integrated sequence stratigraphic approach that incorporates a substantial amount of data into the interpretation. Representative seismic lines, a well log, and biostratigraphic data are presented in the paper. Limited space once again precludes a lot of detail, but the authors do reach some general conclusions regarding the play elements of the study area and suggest that their conclusions could apply to a larger portion of the Texas/ Louisiana offshore. Reservoir occurs in stacked deltaic sands of the highstand systems tract, and in middle Miocene deep water sandstones. Intraformational seals are provided by shales of the transgressive systems tract and by prodelta shales in lowstand prograding complexes. Potential source rocks are associated with Upper Cretaceous and lower Miocene condensed sections.

A paper by Knox and McRae takes a conceptual approach to identifying stratigraphic heterogeneity in upper delta-plain fluvial reservoirs. Subsurface data from the Frio T-C-B Field, along with observations from an outcrop analog, the Cretaceous Ferron Sandstone of Utah, are used to develop a model that relates fluvial style to accommodation (i.e., the space available

for deposition). This relationship is subsequently used to identify the style of fluvial deposition during a cycle of sea level rise and fall, and which style will have the greatest reserve-growth potential. The authors conclude that broad and internally heterogeneous fluvial reservoirs deposited during times of high accommodation possess the greatest reserve-growth potential since past completions have only tapped small reservoir volumes in these strata.

As applicable as this model may be to observations in the Frio T-C-B Field, I would like to see more supporting documentation on various aspects of the conceptual model before I would apply it to other fields containing fluvial reservoirs. However, given the short length of the papers in the Transactions volume, it's understandable that only the major points and conclusions of the study are discussed.

If I may digress to editorial comment, my reason for wanting to more fully understand the basis for this (or any conceptual model) is that allocyclic and autocyclic forcing on a depositional system can vary radically from basin to basin. What works as a predictive concept for strata in one area need not be universally applicable. It's true that certain aspects of many models apparently hold up most of the time (or why have models at all?). I prefer, however, to know what assumptions and facts have gone into a model, and then compare these underlying conditions to those in an area I'm working before I apply the model and draw my conclusions regarding a particular stratigraphic section. As a simple example, the authors in this Frio paper acknowledge that opposite patterns in fluvial style have been observed in the upper and lower delta-plain. Hence, an interpreter must immediately know something about the paleogeography of the interval being worked or a potentially wrong conclusion could be drawn regarding fluvial reservoir geometry and continuity, and, consequently, reserve growth potential. Another point to consider: there may be models with opposite

conclusions with respect to fluvial style as a response to accommodation. Which model is correct? To me, it depends on the parameters upon which the model is based, and how these parameters compare to the deposits to which the model is being applied. In summary, I've always found it best to understand the technical basis and viability of a conceptual model before applying it to an exploration or production situation. Enough said from me. Any comments?

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Field Trip Committee Planning Arbuckle Mountain Trip

By John Turmelle

The HGS Field Trip Committee is planning an informal weekend trip to the Arbuckle Mountain area of southern Oklahoma. Our plan is to leave Houston around noon on a Friday in early April (say April 12, 1996). We'll drive to Ardmore, Oklahoma, pitch camp, watch the stars, and reflect on the geology we'll see the next day. The features of the Arbuckles are contained in a region small enough to fill with one and a half days of exciting stops and be back home by Sunday night.

The Arbuckle Mountains expose a complete section of Lower Paleozoic rocks. Precambrian granites were downdropped into an aulacogen and flooded with Cambrian rhyolites. The Arbuckle Group is 8,000 feet thick along this trend, composed entirely of shallow-water carbonates. Karst

collapse-breccia is common. The overlying Ordovician-aged quartzites of the Simpson group were windblown from the Canadian Shield. These sands are incredibly pure, and in the glass sand quarries surrounding the Arbuckles, contain so little cement they disintegrate grain by grain as though these ancient rocks were deposited on Galveston Island yesterday. Fossil hunters can collect trilobites, brachiopods, and corals from the Silurian, Devonian, and Mississippian rocks that cover the Ordovician aulacogen.

Spectacular folds and faults are present on all scales in the Arbuckle area. We can discuss the Washita Valley Fault, its degree of left-lateral displacement, and its associated oil fields. Two orogenic events created washes that meet the Lower Paleozoic with

angular unconformity. At one locale, we can walk about on an exhumed paleo-oil field. "Rabbit-ears" structures, anticlines that climb the sides of folds, are common features in the Arbuckles. Turner Falls, in the core of the Arbuckles, has an interesting Pleistocene history. Climatic changes caused Honey Creek to carve a canyon through its own fill of travertine deposits.

The Arbuckle Mountains offer interesting geology for everyone from paleontologist to structural geologist, to rockhound to oil finder. If you are interested in this adventure, please call Richard Howe at 376-8744 and provide suggestions that will make this trip fun and informative. Let's make it happen. ■

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Byron F. Dyer

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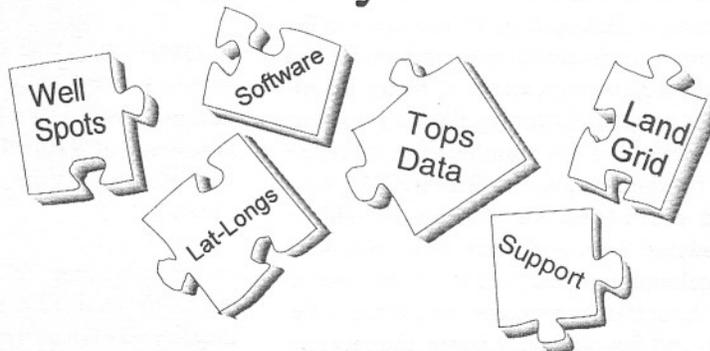
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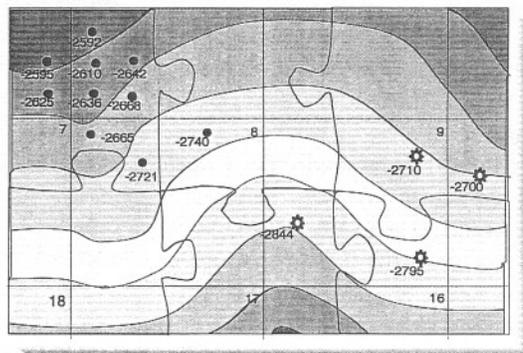
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Legislative Update

By Deborah K. Sacrey, Government Affairs Committee

Many thanks to SIPES and to Jim Bennett, National Director from Houston, for supplying the following information:

Viewpoints and issues involving the consideration of transferring duties of the Minerals Management Service (MMS) to certain states is being considered by a special committee of the Interstate Oil and Gas Compact Commission (IOGCC). According to Wyoming Governor Jim Geringer, Co-chairman of the committee, considerable focus will be placed on such matters as: 1) ground rules for evaluation, 2) collection procedures, 3) audit procedures, 4) uniformity among states, and 5) assurance that any action by the federal government does not impose extra burdens or expenses on the states.

It is interesting that recently enacted legislation and proposed actions among various oil- and gas-producing states have commonalities such as: 1) incentives in the form of tax breaks, 2) more reasonable and even-handed regulation, 3) better definitions of authority for regulation of various agencies, and 4) streamlining of functions of regulatory agencies. The IOGCC, having noted these similarities, should be studying these and other areas of federal regulation that could either be eliminated or the authority for same transferred to the oil- and gas-producing states, thus accomplishing the same goals as the legislation the various states are proposing.

An important precedent has been established in Kansas that could affect operators in Kansas, as well as in other states. Wichita County Commissioners Court approved a plan by Woolsey Petroleum Corp. that would result in a three-year, 50% property tax abatement on productive exploration wells. If approved, Woolsey, of Wichita, would be the first petroleum company in Kansas to receive economic development tax incentives that were created by a 1986 Kansas Constitutional Amendment. Usually, the Kansas ad valorem tax is about 8–12% of annual income; the abatement would reduce it to 4–6% for three years.

Also in Kansas, HB 2471, the Licensing of Geologists, has progressed. Negotiations have taken place between the two dominant engineering societies, and it appears they will support this Bill, while at the same time maintaining the integrity and interest of geologists and petroleum geologists. (Is it possible that Kansas will do what Texas could not?) This bill will be heard during the 1996 Legislative session.

The Louisiana Legislature does not convene again until April 1996; thus, there are no new legislative actions to report. There is, however, continuing talk that consideration may again be given to a tax on gas transported out of Louisiana via interstate pipelines.

In Mississippi, since adjournment of the 1995 Legislature, there are no reportable legislative events.

In Oklahoma, HB 481 was passed. It allows distributors of checks for production proceeds to defer payments under a minimum of \$100. Payments withheld will accumulate until the amount owed exceeds \$100.

In Texas, on June 19, the Coastal Coordinating Council (CCC), which administers the Coastal Management Plan (CMP), proposed 17 rule changes (reported in the HGS Bulletin). In August, two public hearings were held. (I had received notice just three days before the hearing in Austin—no time to get the word out!) These meetings were held so that those wishing to learn more about the CMP could do so, and could submit oral or written commentary to the proposed rule changes. SIPES submitted a letter to the CCC, taking the position that a CMP was not necessary, but was probably inevitable and, therefore, they support the revised plan. SIPES also proposed exemption of oil and gas operations from CMP rules inland of a line 100 yards from coastal waters.

It was previously reported that the inactive well severance tax credit program had

been reauthorized. Actually, the bill (HB767) passed both chambers with similar but different language; however, the Senate failed to concur with the final House version, and the measure failed to pass. The current program for qualifying wells expired on August 31, 1995.

On a national note, Sen. Don Nickles (R-OK) has proposed SB451, which would provide tax incentives to encourage the domestic production of oil and gas. This bill includes tax credits for production from marginal wells as well as providing credits for production from new wells drilled after June 1, 1995. The legislation would mandate certain depletion reforms, such as the repeal of the net income limit for computing percentage depletion, the exclusion of marginal production from the 1,000 barrels-per-day limit, and the repeal of the property allocation rule for computing depletion.

On September 14, 1995, HR 2342, The Natural Gas Competitiveness Act of 1995 was introduced into the House of Representatives by Rep. Lamar Smith (R-TX) and Rep. John Bryant (D-TX). This Bill proposes to modify federal antitrust statutes to enable independents to aggregate and market their gas through cooperative associates, and will be reviewed by the House Judiciary Committee. Representatives on this committee from Texas are: Lamar Smith (R-TX), John Bryant (D-TX), and Sheila Jackson Lee (D-TX). Please contact these representatives if you feel strongly about this proposal. And, if you would, fax a copy of your letter to *Independents for Co-ops* at 713-296-6497.

Not surprisingly, in a meeting held in August, several oilmen had a meeting with President Clinton, and very little was accomplished. The President said that he would look into ways to help the domestic industry "through administrative means" as opposed to legislative means. He was told that the mood of the average oil and gas producer (in Oklahoma) is one of despondency. Clinton appeared to be interested in ways to help the domestic oil

industry. However, he recently called a U.S. House Appropriations Subcommittee on the Interior's vote to lift restrictions on offshore oil and gas drilling a "mistake" and vowed to oppose the move. "This action is a mistake, and I will be no part of it. I will not allow oil and gas drilling off our nation's most sensitive coastlines on my watch," Clinton said in a statement.

The U.S. Department of Energy reports

that world oil markets are likely to be as vulnerable again to monopoly influence as they were during the 1970s, because members of OPEC will regain 50% of the projected production by the year 2000.

New natural gas connections continue a record rise in the U.S. Nearly 1.1 million new natural gas heating customers were connected in 1994. The Gas Research Institute says that annual global gas demand

could grow to more than 28.4 trillion cubic feet by the year 2015. It predicts that total gas demand will expand by 1.5% annually into the next century.

If anyone has additional information pertaining to state or federal bills, and would like to have it reported to the general public, please contact me at 462-0861. Again, my thanks to SIPES and our Editor for supplying necessary "scoop"! ■

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Seeking Nominations

By Dan Bonnet, Awards Committee Chairman

Each year the HGS Awards Committee is responsible for nominating qualified individuals for various AAPG, GCAGS, and HGS awards. With a membership of approximately 4500 individuals, it has become increasingly difficult for the Awards Committee to have knowledge of all qualified candidates. Many individuals with excellent credentials are undoubtedly passed by every year because we are not aware of their activities. If you know of someone who you think is deserving of an award or honor, please contact Dan Bonnet at 650-8008 no later than February 1, 1996.

Specific awards for which we are seeking nominations are:

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- Public Service Award
- Distinguished Service Award
- Journalism Award
- Outstanding Educator

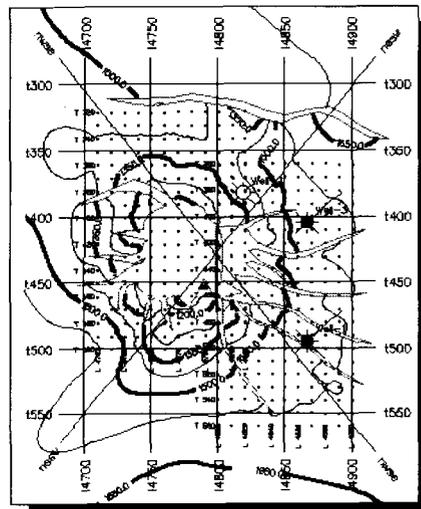
Past winners, description and criteria for each award can be found in the December issue of the *AAPG Bulletin*.

Please try to identify people deserving of recognition so their contributions will not go unnoticed. ■

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Press Release

GeoQuest Acquires Intera Petroleum Division. GeoQuest announces that it has acquired the Intera Petroleum Division, the leading engineering consultancy and reservoir management software company in the oil industry. This acquisition strengthens GeoQuest's position as the petroleum industry's most comprehensive provider of exploration and production (E&P) data services and software.

The Petroleum Division's products include the market-leading ECLIPSE family of reservoir simulators, as well as a wide range of other software products supporting reservoir management. The consultancy group offers integrated field studies to optimize petroleum recovery and reduce production costs. The acquisition was completed for \$57 million plus working capital.

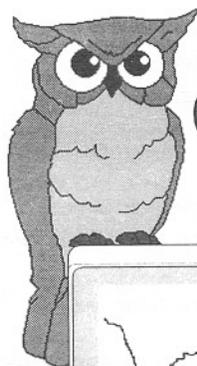
Within GeoQuest, the Intera Petroleum Division has been renamed Reservoir Technologies. Its 200 employees will continue their responsibilities under the on-going management of Randall Archibald, vice president, who will report to Rex Ross. ■

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Geo-Events

HGS JANUARY MEETINGS

January 8

HGS Dinner Meeting (see page 8)

by James F. Fox

"Regional Offshore Interaction of Sediment and Salt, Gulf of Mexico"

Post Oak Doubletree, 2001 Post Oak Blvd. Social Period and Poster Session, 5:30 p.m. Dinner and Meeting 6:30 p.m. Make or cancel reservations by noon Friday, 5th.

January 10

HGS Environmental/Engineering Geologists Dinner Meeting (see page 9)

by John D. Wilson

"Building Environmental Consensus"

Steak & Ale, 8150 Katy Freeway. Dinner 6:00 p.m. Meeting 7:00 p.m. Make reservations by noon Monday, 8th.

HGS International Explorationists Dinner Meeting

There is no meeting scheduled for January.

January 22

HGS North American Dinner Meeting (see page 10)

by William J. Barrett

"Barrett Resources Corporation: Growth of an Independent Through Exploration"

H.E.S.S., 3121 Buffalo Speedway
Social Period 5:30 p.m. Dinner and

Meeting 6:30 p.m. Make or cancel reservations by noon Friday, 19th.

January 24

HGS Luncheon Meeting (see page 11)

by Luca Bertelli, Luca Savini,
Luca Aleotti

"DREAM™—Drilling and Real Time Migration: A New Method for the Geophysical Monitoring of Wells"

Houston Club, 811 Rusk. Social Period 11:30 a.m. Lunch and Meeting 12:00 noon. Make or cancel reservations by noon Monday, 22nd.

HGA EVENTS

January 3 and January 24

HGA Bridge

Briar Club, Timmons & Westheimer
10:00 a.m. - 2:30 p.m.

January 8

HGA Bridge

St. Martin's Church
10:00 a.m. - 2:30 p.m.

January 22

HGA Bridge

Westside Tennis Club
10:00 a.m. - 2:30 p.m.

February 2

HGA Event

"il Carnevale"

Lakeside Country Club

SIPES EVENTS

January 18

SIPES Luncheon

Petroleum Club, 11:30 a.m.

GSH EVENTS

January 9

Best of GSH, Breakfast Meeting

Mobil, 12450 Greenspoint, 7:30 a.m.

January 22

GSH Noon Luncheon

H.E.S.S., 3121 Buffalo Speedway,
11:30 a.m.

JANUARY EVENTS

January 8

AWG Dinner Meeting

Morningside Thai Restaurant, 6:00 p.m.

January 13

ECH Morning Retreat

University of Houston

January 27

HGS Short Course (see page 26)

"Applications, Design, and Interpretation of 3-D Seismic on the PC"

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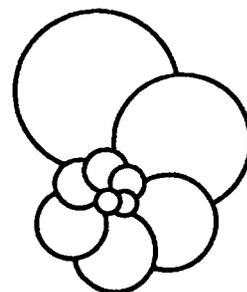
January 1996

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
1 HGS Dinner Sediment & Salt AWG Dinner	2	3	4	5	6	7
8	9 GSH Breakfast	10 Env./Eng. Dinner Env. Consensus	11	12	13 ECH Retreat U of H	14
15 Copy due for March Bulletin	16	17	18 SIPES Luncheon Petroleum Club	19	20	21
22 N. American Dinner Growth of an Independent GSH Luncheon	23	24 HGS Luncheon DREAM	25	26	27 HGS Short Course 3-D on PCs	28
29	30	31	New HGS/GSH VoiceMail Reservation Line: 917-0218 HGS Jobs Hotline: 785-9729			

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HGS Board Divvies Up AAPG Profits

By James A. Ragsdale, President-Elect

BACKGROUND: A local geological society that sponsors an AAPG Convention gets 20% of the profits from that convention. HGS' share from the very successful meeting last April totaled \$102,343. Last summer, President Ron Nelson appointed a "Special Allocations Committee" composed of Executive Board members Larry Bartell, Paul Britt, and James Ragsdale to prepare a recommendation for the use of this money.

At its November meeting, the Executive Board of the Houston Geological Society approved the distribution of the Society's \$102,343 share of the profits from the 1995 AAPG Convention. The Board allocated these funds as follows:

Summary of Allocations (rounded off to \$102,000):

Cash Reserves	\$ 25,500
Continuing Education	25,500
HGS Scholarship Funds	20,000
HGS Publications Fund	5,000
HGS Capital Improvements	16,000
Houston Museum of Natural Science	10,000

The ideas for most of these allocations came from members of the Society who

are not on the Executive Board. All of us on the Board appreciate very much the contributions of the Society as a whole toward this endeavor.

Perhaps the most significant allocation is to Continuing Education. The Board decided to devote 25% of the money, approximately \$25,500, to the improvement of the employability of its members. To this end, President Ron Nelson will appoint a task force to investigate the possibility of providing support for courses in the operation of 3-D seismic workstation software or other advanced technologies. The support would be specifically directed toward unemployed and underemployed members. Several options are under consideration, and the Board encourages suggestions from the membership about this.

The Executive Board decided to put another 25% of these funds (\$25,500) into the Society's Cash Reserves. HGS now has a little over \$240,000 in reserves, about one-half of a year's budget.

The Society has two funds, managed separately from HGS, for College Scholarships. The Board is donating \$10,000 to each of these entities, the Undergraduate Scholarship Fund and the Calvert Memorial Scholarship Fund for graduate students.

HGS has traditionally been very active in publishing scientific books. The money for printing these volumes typically has come from the Society's operating income. Although our organization almost always gets its money back, the Board thought that it would cause less strain on our operating budget if we had a permanent Publications Fund from which we could draw funds for books. The Board allocated \$5,000 to set up this fund.

We set aside \$16,000 for general Capital Improvements. These include computer upgrades for the HGS office, which will cost approximately \$5,000, and \$2,400 to meet some specific needs of some of the Society's committees. About \$8,600 remains unallocated and available. More ideas would be welcomed.

HGS has had a long-standing relationship with the Houston Museum of Natural Science. Many of our members have volunteered their time and their money to help this institution. The Board believes that because of this relationship and the wonderful contribution the museum makes to the general education of the city, the \$10,000 gift, specifically designated to the Wiess Energy Hall, is well-deserved. ■



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 - 5) Prorated salaries of Geoscientists (learning the system, dealing with "bugs", etc.) _____
- TOTAL A** _____
- 1) Prorated salaries of Geoscientists (working on oil-finding) _____
- TOTAL B** _____
- TOTAL B / TOTAL A = Productive oil-finding percentage:** _____

How many prospects per month is this investment yielding?

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While many companies now have their own workstations, some are concluding that this is not helping them find oil and gas cost-effectively. Geoscientists find themselves "punching buttons" and working the way a programmer decided rather than the way they want. In addition, with reduced staffing they are asked to be workstation experts, oil-finders, and managers at the same time; an almost impossible task. If you are experiencing this problem, it's time for a **new solution**.

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Qualifications for Active Membership

- 1) Have a degree in geology or the earth sciences from an accredited college or university; or
- 2) Have a degree in science or engineering from an accredited college or university and be directly engaged in the application of the earth sciences; or,
- 3) Have been engaged in earth science work during the preceding five years.

Annual Dues are \$18, which includes \$9 for the *HGS Bulletin*. Fulltime students and emeritus members pay \$9.

Mail this application and a check to:
Houston Geological Society
7171 Harwin, Suite 314
Houston, TX 77036
Telephone (713) 785-6402

HGS operates on a fiscal year of July 1 - June 30.

Qualifications for Associate Membership

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

To the Executive Board: I hereby apply for active associate membership in the Houston Geological Society and pledge to abide by its Constitution and Bylaws.

Name: _____

Address: _____

Home Phone: _____ Spouse's Name: _____

Job Title: _____

Company: _____

Company's Address: _____

Work Phone: _____ Fax Number: _____

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 and offshore)

School _____

Degree _____ Major _____ Year _____

School _____

Degree _____ Major _____ Year _____

School _____

Degree _____ Major _____ Year _____

Work Experience _____

Applicant's Signature _____ Date _____

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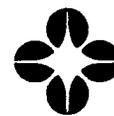
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HGS Continuing Education Short Course

Applications, Design, and Interpretation of 3-D Seismic on the PC

Date: Saturday, January 27, 1996
Time: 9:00 a.m. to 4:30 p.m.
Location: PCIII Computer Systems, Inc.,
 10805 Seaboard Loop, Houston, TX 77099
 (near West Bellfort and Wilcrest; please call HGS to
 have directions sent to you.)

Course Description: This one-day course is for geologists and geophysicists to learn about the benefits and pitfalls of 3-D seismic data. The format is a mixture of lectures and hands-on workshops, working with PC workstations on several 3-D seismic surveys of reservoirs. Lectures include interactive computer graphics. This course will explain the use of 3-D seismic, and the presentation will touch on key points of economics, design, data processing, and the components of a 3-D program. A structural workshop involves horizon picking using several wells with formation tops, and seismic amplitude will be used to delineate the reservoir. A stratigraphic workshop on the Stratton Field 3-D survey will investigate seismic properties for stratigraphic plays. A short question-and-answer session will precede the lunch break. Usually only two people will work at each workstation.

Instructors: Dr. Tom Smith, President and Geophysicist of Seismic Microtechnology, and Mr. Larry Wipperman, Geophysicist of Seismic Microtechnology.

Course Limits: Minimum 9 students, maximum 24.
Price: \$100 by Thursday, January 25, 1996. At door \$125.
Register by phone: Call Margaret at the HGS office (785-6402).
Register by mail: Send Name, Address, Telephone no., **Fax no.** (for directions to class) and payment to:
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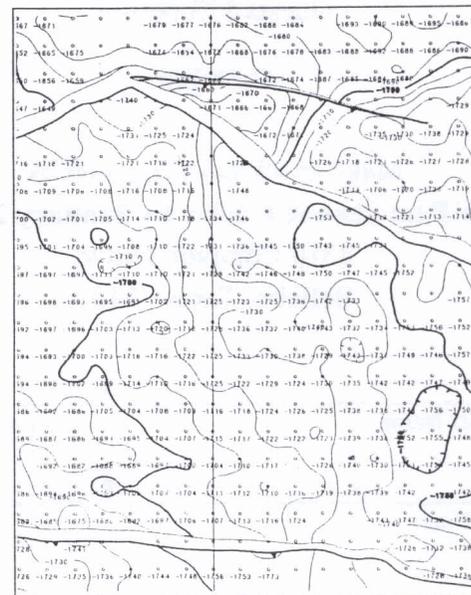
ALL of these 3-D seismic interpretation systems provide essentially the same data: seismic horizons and seismic faults. And, all of these data are essentially useless because they do not include fault vertical displacement. Fault vertical displacement is the single most important variable when processing faulted systems in three dimensions, i.e., multi-surface.

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The Association for Women Geoscientists is pleased to announce that at least two Chrysalis Scholarships will be awarded on March 31, 1996. The \$750 awards will be given to geoscience M.S. or Ph.D. candidates to cover expenses associated with finishing their theses. The Chrysalis Scholarship is for women who have returned to school after an interruption in their education of one year or longer. The support can be used for anything necessary to assist the candidate in completing her thesis, such as typing, drafting expenses, field work, or child care.

Applications should be made by February 28, 1996. The applicant should write a letter stating her background, career goals and objectives, her involvement in both the geosciences and her community, how she will use the money, and explaining the length and nature of the interruption to her education.

The applicant should also submit two letters of reference. The reference letters should include a statement of the applicant's prospects for future contributions to both the geosciences and her community. Her thesis advisor should also

include when the candidate will finish her degree and what requirements are as yet to be completed.

For information on obtaining an application or for additional information please contact:

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HGS Luncheon Price to Increase

By Ann Martin, Vice-President

Well, we have some good news and some bad news. The bad news is that the Houston Club has raised the base cost of our luncheon service. Therefore, an HGS Luncheon ticket will increase in price from \$15.00 to \$17.00 effective February 1, 1996. Thanks to years of tough negotiating by our Arrangements Chairmen, luncheon prices have remained unchanged since 1988. Unfortunately, we can no longer postpone this step.

The good news is that the HGS still provides an excellent forum for Houston's geological community. Lectures, poster sessions, seminars, and field trips are all available for bargain prices. Geologists can brush shoulders with their technical peers, exchange ideas, update skills, and argue over interpretive displays while maintaining those professional contacts that are so important in a competitive job market.

Each year, the HGS Board struggles to maintain these benefits while balancing our annual budget. For the most part, we hold the line in spite of slimmer margins and smaller reserves than many of our sister societies. We regret this Luncheon price increase, but we look forward to continued service to the geological community in the Society's sound, fiscally responsible manner. ■

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Definitions	oil	volatile oil	(retrograde) oil	gas-condensate	wet gas	dry gas	dry gas
Recovery	water injection		dry gas re-cycling				depletion

On the Move

Jim Lantz has relocated from Houston to the mountains of Evergreen, Colorado, where he now happily wakes up every morning at 7800' looking out his bedroom window at the snow-covered rocks of 14,000' Mt. Evans. Jim is a member of Amoco Production Company's Northwest U.S. Growth Team in Denver, and can be reached at 303-830-4144, or via e-mail at jrlantz@amoco.com.

Terry L. Leyenberger, has joined Union Texas Petroleum, Houston, as Senior Staff Geologist. He was previously with Exxon Exploration Company, Middle East New Ventures. Mr. Leyenberger's telephone number is (713) 968-2450.

Andy J. Lydyard has been promoted to Vice President of Exploration at J. M. Huber Corporation, Oil and Gas Division. Huber's offices are at 1900 West Loop South, Suite 1600, Houston TX 77027. Mr. Lydyard can be reached at (713) 871-4520.

Joseph W. McGee has accepted a position as Project Geologist with Buena Engineers, 3021 South Valley View, Suite 104, Las Vegas NV 89102, telephone number (702) 227-1944. Mr. McGee was formerly with Western Technologies, PetroVal Inc., Mark Producing, LL&E, and Cities Service Company. ■

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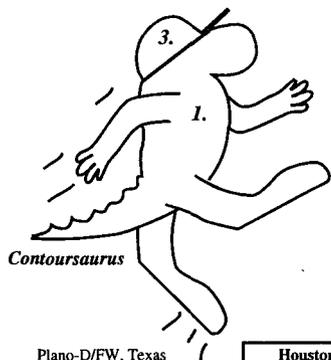
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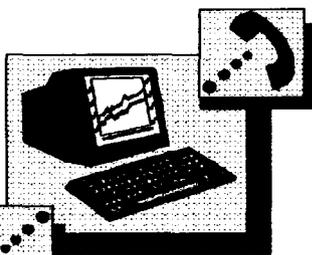
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Dinosaur Footprint Field Trip Rescheduled

By Robert F. Kukowski

The Dinosaur Footprint field trip originally scheduled for October 14, 1995 is rescheduled for **Saturday, April 27, 1996**. The times and places on the original schedule will have only minor changes. This rescheduling was necessary since we only received 17 applications. Please watch the February and March issues of the *Bulletin* for additional information and an application form. I hope to see more of you sign up for the 1996 trip. See you then.n

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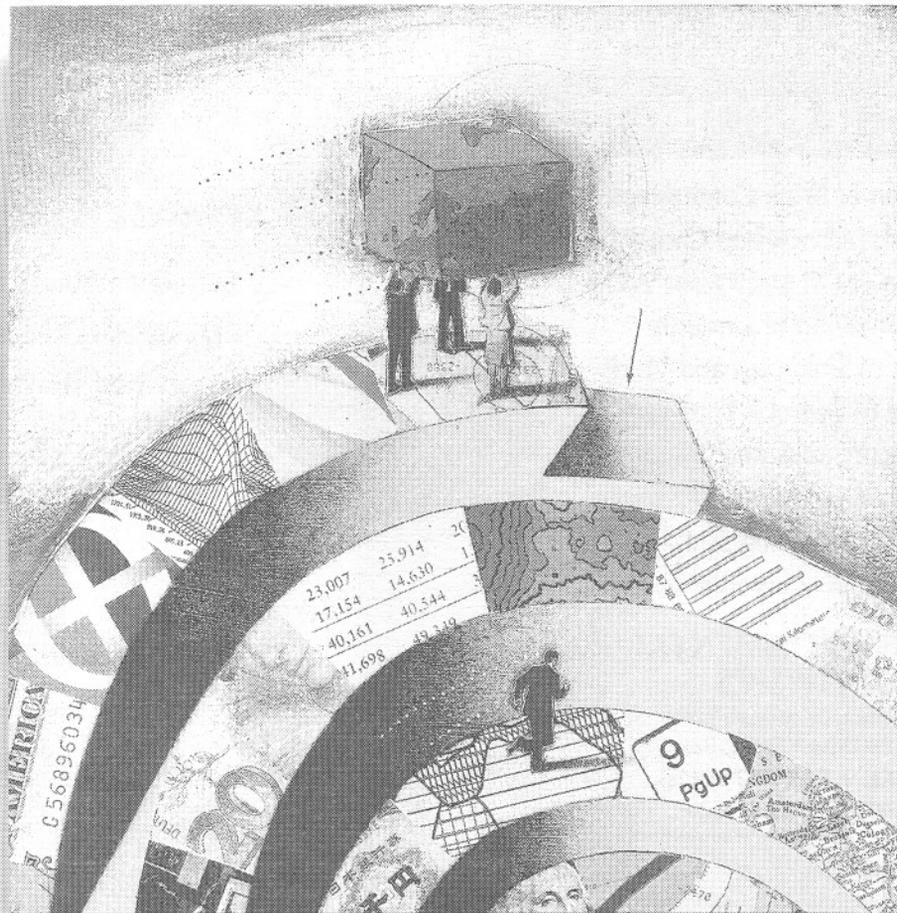
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The Global Energy Industry in the Early 21st Century

By Victor A. Schmidt

Price Waterhouse brought together industry experts and executives for its annual meeting in Houston during the first week of November 1995. Topics included: the growing role of natural gas in the world's energy mix and its future in electric power generation, the changing major oil company, knowledge-based oil companies, oil service firms, and the changing role of OPEC.

The world has adapted to both low oil prices and lower cost production. Expected oil demand growth of 1 million barrels per day per year may be too low and could be as high as 2 million barrels per day per year. Growth will be driven by higher per capita income and higher demand for transport fuels in India, China and Russia. Significant worldwide growth for natural gas in the next 15 years is expected. The world has an estimated 5,200 TCF of natural gas reserves; the key will be linking the 75 percent of world reserves located in the Middle

East and Russia to the growing markets of the world in South America, Europe, and the Far East. To fully develop these resources, the different parts of the value chain must be linked together in win-win contracts before construction can begin. LNG will expand to serve distant markets and natural gas will one day be as widely traded as oil.

Uncertainty will continue in the oil markets. Refiners will need to be cautious; oil is still concentrated in the Middle East, which has continuing instability. Refiners need to take an active role in government policy development as demand is becoming more regionalized. Refiners using just-in-time management of oil stocks are being complacent and are at risk for a new oil shock.

By 2010, the role of the independent power producer will be expanded, and with it increasing demand for fossil fuels. They see

demand requiring a 50 percent increase in the world's electric generating capacity to a total of 15.1 trillion kilowatt-hours of capacity. New power sources to replace coal, oil, and natural gas are not anticipated. Major capital outlays will be required and, therefore, countries must create a climate for that investment to receive a fair, risk-adjusted return.

Oil companies will need to redefine their social mission. An active role is needed to create a cooperative, team-building spirit with the public, environmentalists, and government. The company must create good shareholder returns and be efficient. It will be decentralized, with autonomous units outsourcing up to 40 percent of their needs. Oil companies will deliver data just in time to high-impact multi-discipline teams, resulting in better decisions made faster. Oil companies must rely on fewer employees and create a richer, more satisfying work experience. ■

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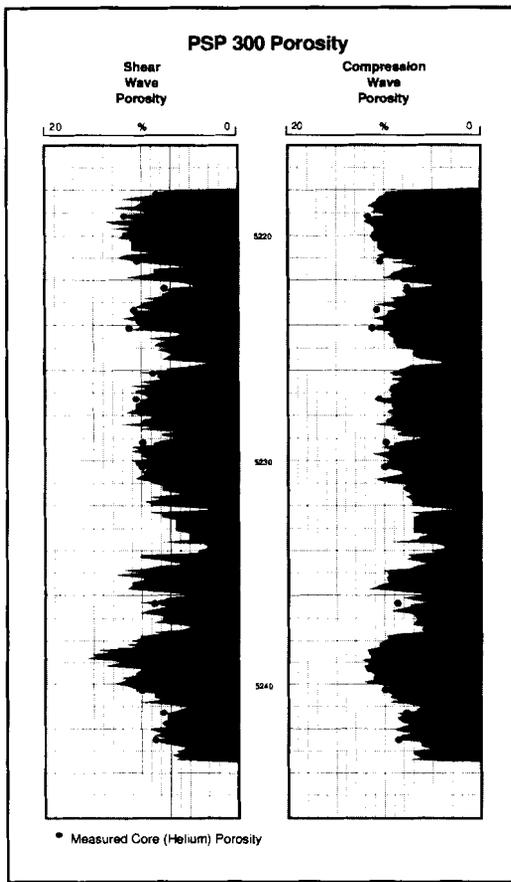
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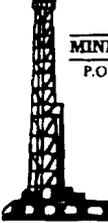
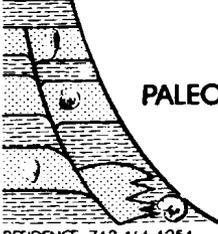
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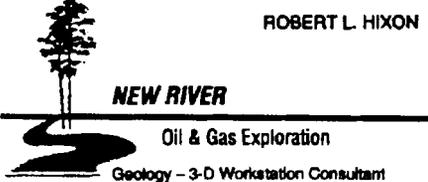
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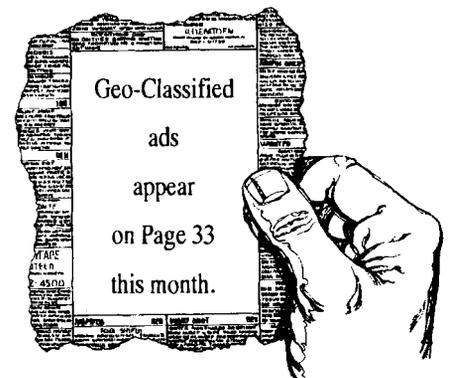
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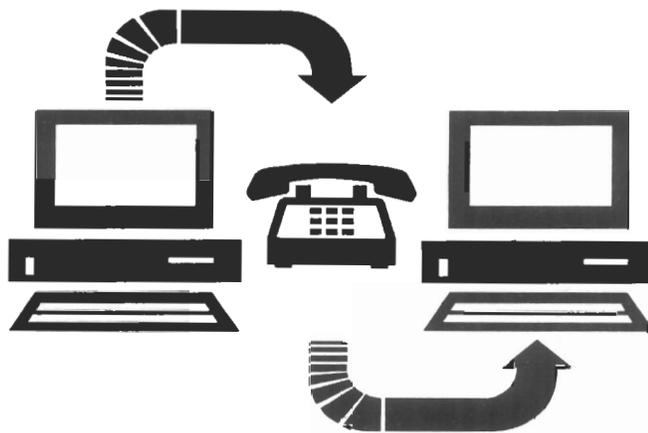
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