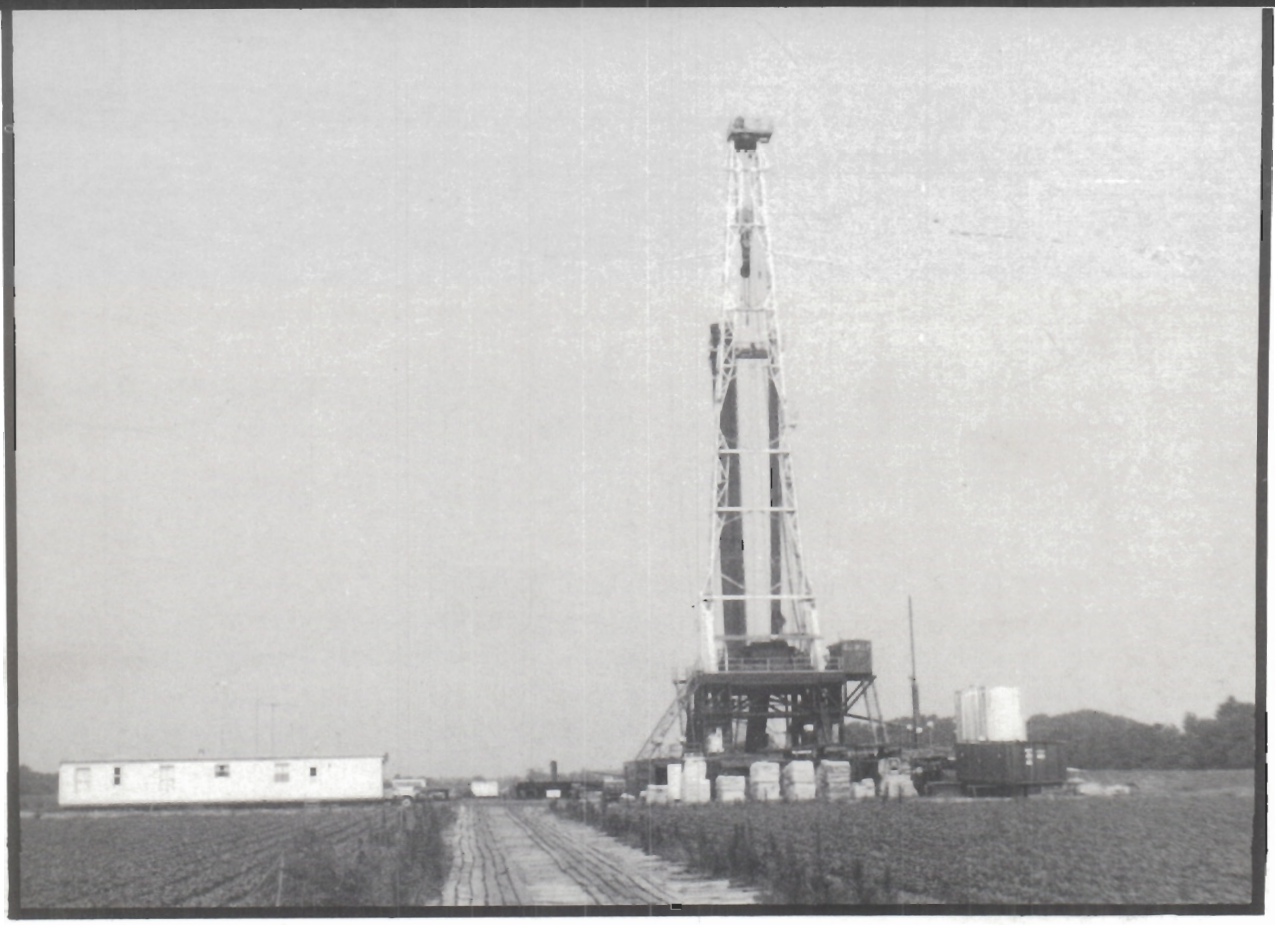
January, 1991

BULLETIN

HOUSTON GEOLOGICAL SOCIETY

Volume 33
Number 5



TWO OUTSTANDING SHORT COURSES!

"Climate Models" and "Mastery of Learning" See page 39

MARDI GRAS MANIA See page 40

TAKE CONTINENTAL TO TOKYO See page 34

IN THIS ISSUE...

AND MORE!

(For January Events, see page 1 and Geoevents section, page 33)

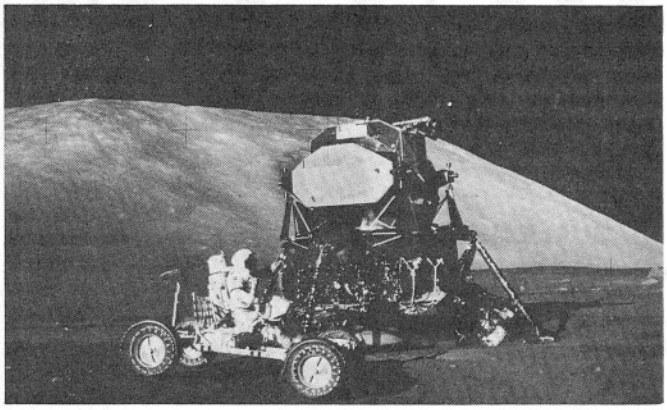
HGS JANUARY EVENTS

MEETINGS

JANUARY 9, 1991 (Dinner Meeting)
HGS ENVIRONMENTAL/ENGINEERING GEOLOGISTS
"Applications of Soil Gas Geochemical Methods In The Detection of Underground Contamination"
Victor T. Jones, III (see page 24)
Charlie's Hamburger Joint, 2222 Ella Blvd., about 1/4 mile south of the 610 Loop.
6:30 p.m. (Buy your own dinner)

JANUARY 15, 1991 (Dinner Meeting)
HGS PERMIAN BASIN/MID-CONTINENT EXPLORATIONISTS
"Berlin Field: Genesis of a Recycled Detrital Dolomite Reservoir, Deep Anadarko Basin, Oklahoma"
J. Reed Lyday (see page 28)
Westin Oaks Hotel, 5011 Westheimer
Dinner and Meeting 6:00 p.m.
Reservations made by name only, telephone **785-6402.** Must be **made** or **cancelled** by **noon Friday, January 11.**

JANUARY 16, 1991 (Dinner Meeting)
HGS INTERNATIONAL EXPLORATIONISTS
"Structure of the Eastern Cordillera of Colombia: A Tectonic Model for the Colombian Andes"
Carlos A. Dengo (see page 14)
Westin Oaks Hotel, 5011 Westheimer
Social Period 5:30 p.m., Dinner and Meeting 6:30 p.m.
Reservations by name only, telephone **785-6402.** Must be **made** or **cancelled** by **noon Monday, January 14.**



Apollo 17 Commander Eugene A. Cernan drove the Lunar Roving Vehicle through a series of maneuvers near the Lunar Module (LM) to check its performance before loading the equipment to be used during the first EVA. The crest of South Massif forms the high skyline 2500 meters above the LM; base of the mountain is 5 km from the camera. The surface disturbed by Apollo 17 LM Pilot Harrison H. (Hack) Schmitt as he walked from the LM to take this picture forms a broad, darker gray area along the left edge and bottom of the scene.

The upcoming **HGS Field Trip** to the **Johnson Space Center** will include a viewing of the moon rocks and other related facilities.

JANUARY 22, 1991 (HAPL/HGS Joint Dinner Meeting)
"Exploration and Production Opportunities in the Soviet Union"
Max G. Pitcher (see page 11)
Westin Galleria Hotel, 5060 West Alabama
Social Period 5:30 p.m., Dinner and Meeting 6:30 p.m.
Reservations by name only, telephone **785-6402.** Must be **made** or **cancelled** by **noon Friday, January 18.**

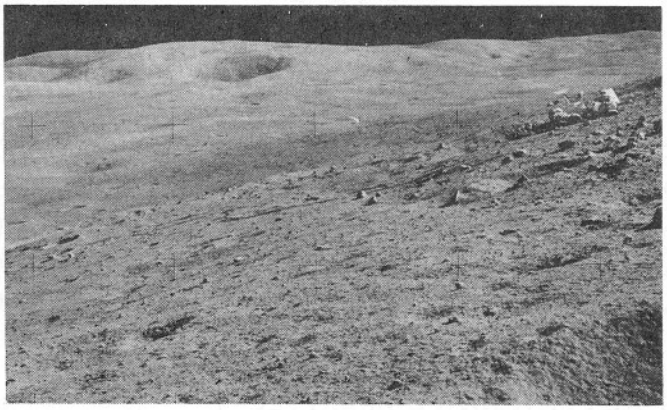
JANUARY 30, 1991 (Luncheon Meeting)
"The Maurice Field: New Gas Reserves From Buried Structure Along The Oligocene Trend of Southwestern Louisiana"
Michael P. Prescott (see page 12)
Houston Club, 811 Rusk
Social Period 11:30 a.m., Lunch and Meeting 12:00 noon.
Reservations made by name only, **telephone 785-6402.** Must be **made** or **cancelled** by **noon Monday, January 28.**

SEMINARS, COURSES, AND ENTERTAINMENT

JANUARY 17, 1991 (Short Course)
HGS ENVIRONMENTAL/ENGINEERING GEOLOGISTS
"Direct-Current (Surface) Electrical Resistivity Hybrid Expert Network For Groundwater Modeling"
HAL PC Office, 1200 Post Oak
7:00 - 9:00 p.m. (see page 24)

JANUARY 26, 1991 (Field Trip)
"Johnson Space Center and Lunar and Planetary Institute"
Rice University Stadium Parking Lot
8:45 a.m. - 2:00 p.m. (see page 38)

FEBRUARY 1, 1991 (Entertainment)
HOUSTON GEOLOGICAL AUXILIARY
"Mardi Gras Mania" (Dinner/Dance)
Lakeside Country Club, 100 Wilcrest
Cocktails 7:00 p.m., Dinner 8:00 p.m. (see page 40).



The astronauts parked the Lunar Roving Vehicle (LRV) in a crater on the lower slopes of Stone Mountain at the southernmost point examined during the second EVA at the Apollo 16 site. They drove up slopes near the limit negotiable in the LRV to sample a band of boulders believed to be ejected from South Ray Crater, a 600-m-diameter crater located 4 km to the west. Smokey Mountain forms the distant skyline; its base is 7-1/2 km from the camera.

HOUSTON GEOLOGICAL SOCIETY

BULLETIN

Vol. 33, No. 5 January, 1991

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DEPARTMENTS

COLUMNS/ARTICLES

PRICE SCHEDULE— JANUARY MEETINGS

(Non-members: add $2.00 to the meal price)

Permian Basin/Mid-Continent Explorationists
Dinner Meeting
Westin Oaks Hotel, Jan. 15 ..... $20.00

HGS International Explorationists
Dinner Meeting
Westin Oaks Hotel, Jan. 16 ..... $20.00
HAPL/HGS Joint Dinner Meeting
Westin Galleria Hotel, Jan. 22 ..... $20.00
HGS Luncheon Meeting
Houston Club, Jan. 30 ..... $15.00

RESERVATIONS POLICY

Reservations are made by calling the HGS office (785-6402). At the meeting, names are checked against the reservation list. Those with reservations will be sold tickets immediately. **Those without reservations will be asked to wait for available seats, and a $2 surcharge will be added to the price of the ticket. All who do not honor their reservations will be billed for the price of the meal.** If a reservation cannot be kept, please cancel or send someone in your place.

The Houston Geological Society office is located at **7171 Harwin, Suite 314, Houston, Texas 77036.** The telephone number is **(713) 785-6402.**

COLUMNS/ARTICLES

Page

COVER PHOTO

The Grey Wolf Rig #7 is shown drilling the NORCEN EXPLORER 1-Trahan, discovery well for the MARG. TEX. (Reservoir C), in Maurice Field located six miles southwest of Lafayette, Louisiana. Michael P. Prescott will present his award-winning talk on Maurice Field at the January 30th luncheon meeting (see page 12 for abstract).

FUTURE HGS MEETINGS AND EVENTS (February)

FEBRUARY 9, 1991 (Field Trip)
"Introduction to Geoscience Workstations"
Sierra Geophysics, 10:00 a.m. (see page 38)

FEBRUARY 11, 1991 (Dinner Meeting)
"Complex Reservoir Geometry in High Island A-467 Field, Gulf of Mexico"
Gary Mitch
Westin Oaks, 5:30 p.m.

FEBRUARY 13, 1991 (International Dinner Meeting)
"Vertical Oil Migration"
Westin Oaks, 5:30 p.m.

FEBRUARY 15-17, 1991
"Mastery of Learning"
Chris Welsh (see page 39)

FEBRUARY 17-22, 1991
HOUSTON GEOTECH
Westin Galleria Hotel, 5060 West Alabama

FEBRUARY 21-22, 1991
"Application of Climate Models to Paleoenvironmental Prediction," Short Course
Eric Barron (see page 39)
Amoco Production Co., WestLake Park Blvd.

FEBRUARY 26-27, 1991
"Introduction to RCRA/CERCLA Environmental Regulations"
Short Course (see page 25)

FEBRUARY 27, 1991 (Luncheon Meeting)
Houston Club, 11:30 a.m.

HOUSTON GEOTECH 91

An Association Of
Geophysical Society of Houston — Houston Geological Society — Gulf Coast SPE — Houston SPWLA

Westin Galleria, Houston - February 17-22, 1991

Registration Fees:

Advance Registration	$ 80.00
On-Site Registration	$100.00
One-Day Registration	$ 45.00

The technical sessions planned for the Geotech include: Hardware trends, data management tools, geographic information systems, mapping, computer-aided exploration, petrophysics, geology, reservoir engineering, geophysics, artificial intelligence, neural networks, robotics, 3D visualization, and 3D circle shoot.

HOUSTON GEOLOGICAL SOCIETY
7171 Harwin, Suite 314 Houston, Texas 77036
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Rememberances	**Renee Elosegui,** Petroleum Information	961-5660
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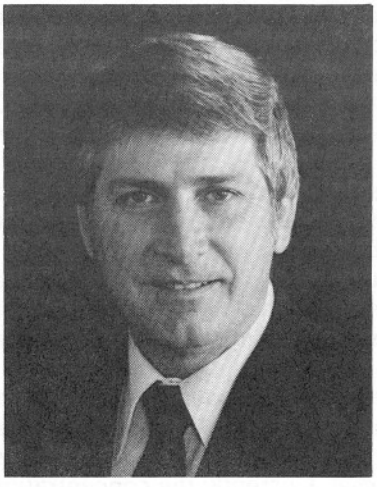
Parliamentarian	**Mrs. Jim (Jerry) Wheeler**	468-8233

The Houston Geological Society *Bulletin* is published monthly September through June by the Houston Geological Society, 7171 Harwin, Suite 314, Houston, Texas 77036. Subscription to the *Bulletin* is included in membership dues ($18.00 annually). Subscription price for non-members within the contiguous U.S. is $18.00 per year and $36.00 per year for those outside the contiguous U.S. Single copy price is $2.50. Subscriptions received after March 1 will be applied to the remainder of the fiscal year (ending with the June issue) and also to the following year.

The Houston Geological Society was founded in 1923 and incorporated in 1975. The Society's objectives are to stimulate interest and promote the advancement of geology in this area, to disseminate and facilitate discussion of geological information, and to enhance professional interrelationships among geologists. The Society includes over 5,000 members locally and publishes special scientific publications in addition to a monthly *Bulletin*. The HGS also provides student scholarships and continuing education programs for professional geologists.

PRESIDENT'S COMMENTS



Deet Schumacher (HGS Past President) agreed to chair an *ad hoc* committee charged with reviewing and recommending changes to the HGS Constitution and Bylaws. Deet's committee was composed of present and past HGS Presidents, Treasurers, Editors and the current Membership chairman. Most of the proposed changes you voted on last month were designed to provide for continuity between successive administrations and to clarify and streamline membership qualifications.

HGS, like other healthy organizations, continues to change and expand to meet the needs of our membership. Our membership currently exceeds 5300 members (record high and growing) and now includes an expanding number of hydrologists, engineering geologists and environmental geoscientists. Because of this growth (scale and diversity), the workload for certain functions frequently exceeds reasonable expectations for a volunteer organization. In order to share the workload and to provide for continuity, Deet's committee recommended the addition of both a Treasurer-elect and Editor-elect. Because the Editor's duties rank equivalent in importance to the Board Members (including President), Deet's committee recommended elevating the Editor's position to Officer and Board status. Next spring, it is anticipated we will elect a Treasurer, Treasurer-elect, Editor and Editor-elect. Subsequent elections will require only the election of the two elect positions.

Other recommended constitution and bylaws changes were designed to provide the Board with the flexibility to amend Standing committees (add and delete) as needed without requiring membership approval.

* * * * * * * * * *

GOOD NEWS, GOOD NEWS - Two of our members distinguished themselves at the recent GCAGS Convention in Lafayette when **Michael P. Prescott** was awarded the **A. I. Levorsen Award** (GCAGS Best Paper Award) and **Jory A. Pacht** was awarded the GCSSEPM **Excellence of Presentation Award.**

Also, the AAPG Executive Committee has approved the AAPG's Advisory Council's recommendations for honors and awards to be presented at the annual national meeting to be held in Dallas beginning on April 7, 1991. Five of our membership will receive awards; they are:

Honorary Membership - **William E. Gipson** and **Peter R. Vail**

Michael T. Halbouty
Human Needs Award - **Roy M. Huffington**

Distinguished Service Award - **George C. Hardin, Jr.** and **Robert M. Sneider**

Congratulations to each of you! Awards such as these can only be earned through hard work and years of unwavering and outstanding service. We (HGS Membership) are proud of you. We are also proud of our Awards Committee for providing to AAPG the documentation required to gain this recognition.

Yours truly,

Ron Harlan

Ron Harlan

LETTERS TO THE EDITOR

To the Editor:

In the November issue of the *Bulletin* you published an editorial by P. H. Abelson from "Science" in the Environmental Notes section entitled "Uncertainties About Global Warming". Abelson noted that there are still many questions to be answered before a prediction can be made as to when the effects of higher levels of carbon dioxide will start to change our climate. He also mentioned that many studies are looking at the effect of a doubling of greenhouse gasses in their models of global warming. Abelson then went on to discredit the presumption of these studies that this doubling would occur by 2050 saying that doubling might take 200 years or more depending on the availability of coal or oil for use by the "less developed countries".

Atmospheric scientists may like to use computer modeling to predict the future, but as a geologist I look more for information from the past. On that basis there is one thing that is **not** uncertain and that is the record of past climates and the level of CO_2 concentration.

From ice core data there is a record of the atmospheric concentration of carbon dioxide over the last 160,000 years (fig. 1). During this time the climate went through two glacial cycles. The graph starts on the left in a glaciation with CO_2 concentrations of 190 to 200 ml/l which is followed by an interglacial with levels of about 280 ml/l. After a drop from 280 to the 250 level there is a continued decrease to the 200 range culminating in the last glaciation ending about 10,000 years ago. This was followed by a rise to 280 ml/l during the current integlacial. Thus, if CO_2 is the trigger for climatic change, then a change from 200 to 280, a total change of 80 ml/1, is sufficient to move the climate between glacial and interglacial conditions.

Figure 2 has the record of CO_2 over the last 1000 years. The concentration was about 280 ml/l until the middle of the 1800's. Since that time the concentration has increased by 70 ml/l to the 350 level. Currently the concentration is increasing at an accelerating rate. If CO_2 concentration is

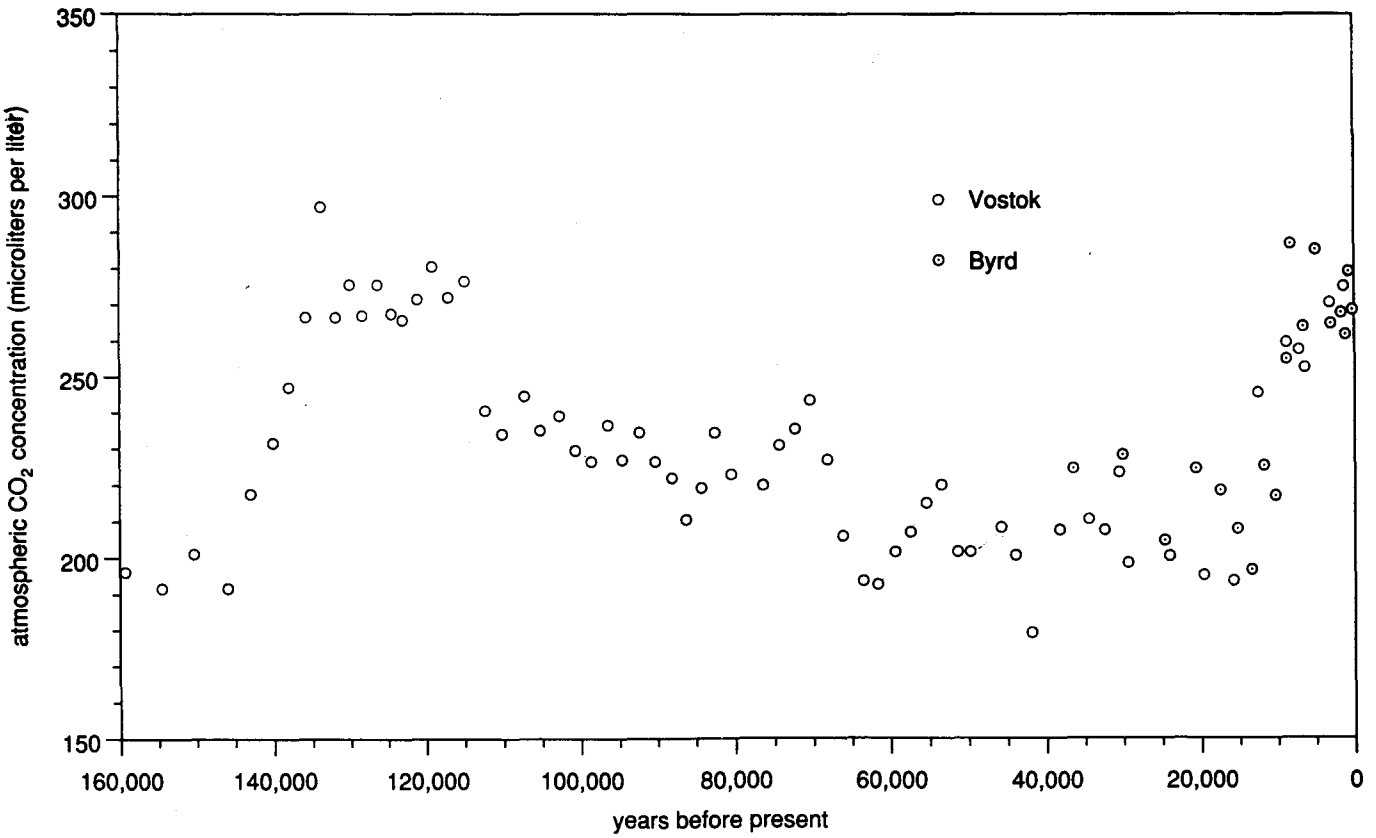


Fig. 1 Carbon dioxide concentrations in the atmosphere have varied over the glacial cycles of the earth's history, peaking at just under 300 microliters per liter of air during the interglacial period approximately 130,000 years ago and reaching that level again at the end of the last glaciation 10,000 years ago. This graph shows CO_2 measurements from air bubbles trapped in Antarctic ice sampled at Vostok and Byrd stations (Barnola *et al.* 1987, Neftel *et al.* 1982). Reprinted from Post *et al* 1990.

the determining factor in world climate, **then we have already reached levels that will result in warming of the same magnitude as a change from glacial to interglacial climate.** Thus, a doubling of CO_2 is not needed to effect major climate change.

The question then becomes a matter of when will the change occur. My own feeling is that what we need to measure are the temperature of the ocean basins and the shallower seas such as our own Gulf of Mexico. These represent the great heat sinks of the earth. When they change, then the climate changes. There are already some indications that the deep waters of the Mediteranean are warming.

As geologists we should have an important role in studying the effect of climate change and the effect of warming on the earth. An example are beach ridges inland from the current Texas coastline formed during a warmer period of an interglacial as well as deep canyons cut during the last glaciation, both dramatic evidence of climatic change.

At the current time there are no alternatives to the use of fossil fuels in our world. Until some new energy source is discovered we can at least mitigate the damage by the use of those dreaded techniques, conservation and efficiency.

When will the Gulf of Mexico become a new Caribbean? Maybe sooner than we imagine and it may not stop there. Welcome to endless summer, Houston.

Hank Bauerlein

REFERENCES

Abelson, P. H. 1990. "Uncertainties About Global Warming" **Science** 247:1529

Post, W., T. Peng, W. Emmanuel, A. King, V. Dale, and D. DeAngelis. 1990. "The Global Carbon Cycle". **American Scientist.** 78:310-326.

Figures 1 and 2 reprinted from Post *et al, 1990, by permission of* **American Scientist,** Journal of Sigma Xi, The Scientific Research Society.

Advertising Rates

To the Editor:

As a 1/8 page advertiser in our Society's publication, I was disappointed when notified my rates would be increased from $484.00 to $726.00. I have supported the Society and the publication for years and feel embarrassed that I have been priced out of it.

Just an Independent Oilman

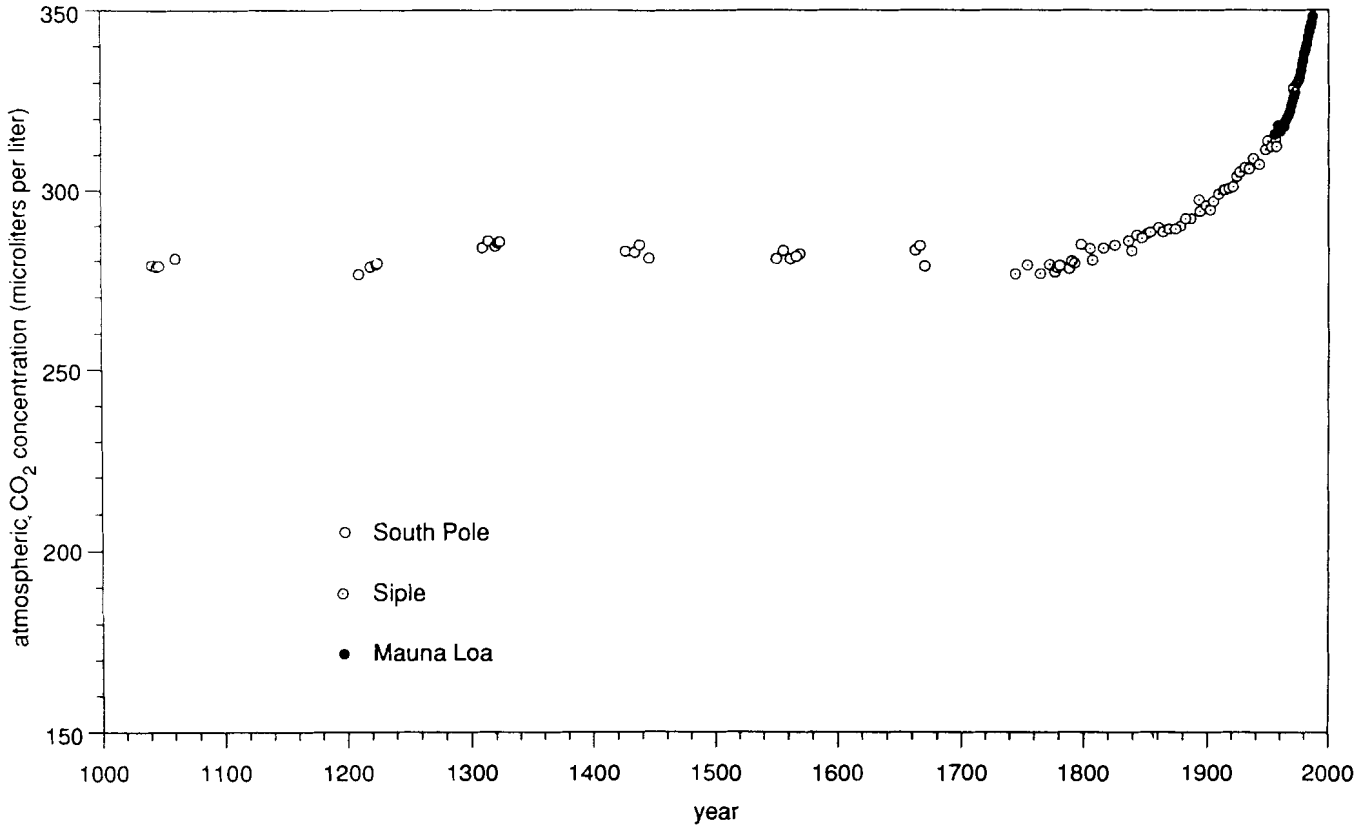


Fig. 2 Atmospheric CO_2 began increasing in the 18th century, and direct measurements made at Mauna Loa Observatory in Hawaii since 1958 indicate that the increase has accelerated. In 1988 the atmospheric carbon reservoir was estimated at 748 gigatons, equivalent to a CO_2 concentration of 351 microliters per liter and larger than at any time during the past 160,000 years. The South Pole and Syole ice core date are from Neftel *et al.* 1985, Friedli *et al.* 1986 and Siegenthaler *et al.* 1988. Reprinted from Post *et al.* 1990.

Dear Independent:

Please don't feel embarrassed by being priced out. There were some "biggies" with the same complaint. We appreciate your advertising in the past and we appreciate your criticism now.

The decision to increase rates was not done without considerable background research and discussion by the appropriate *Bulletin's* staff, board members and president.

A decision was made by this group to try and make the *Bulletin* a self-supporting endeavor. Historically, the *Bulletin* has never been entirely self-supporting. That means that ad revenues have not covered the cost of printing and mailing the *Bulletin*. During the past five years, *Bulletin* operations have lost from approximately $40,000 to $15,000 per year. (The last two years, 1988-89 and 1989-90, incidentally, were two of the best years the HGS ever had. In both cases, the short-falls were between $15,000-$20,000). Increasing pressures on the *Bulletin*, including the increased number of meetings, articles and members, have raised anticipated *Bulletin* costs to about $100,000 this year. Ad revenues last year were about $65,000. Thus, a short-fall of $35,000 per year was projected unless ad rates were raised.

Our perception is that the increased number of quality articles and news events have made the HGS *Bulletin* the premiere publication of its kind, a publication that the world's largest local geological society can be proud of.

Additionally, we compared our new ad rates to other geological societies, to the SPE magazine and to the Houston Business Journal; our 1991 rates are in line with those magazines when compared on a per capita basis.

Sincerely,
Don Neville
Advertising Committee Chairman

Seeking

To the Editor:

While recently reorganizing my consulting geological practice and reading some unread or under-read previous publications, I came upon the very interesting feature article titled "The King Survey*." It is bylined to Mary C. Rabbitt and Clifford M. Nelson. It appeared in the June 1990 HGS *Bulletin*, Page 31.

During the Korean Emergency, I was a temporary Interior Department employee (Petroleum Administration for Defense), allocating tubular goods to such struggling independents as Michel Halbouty, the late George Coates and Barnett Serio. If recollection serves correctly, I came across a USGS directory that listed a geologist named Mary Rabbitt. I was told by someone — who I suspected of "pulling my leg" — that there indeed was such a lady USGS geologist who happened to be married to another geologist named John (nicknamed "Jack") Rabbitt.

If you can, would you publish some brief biographic information about authors Rabbitt and Nelson?

Sincerely yours,
Harrison T. "Spud" Brundage

Dear Mr. Brundage,

The *Bulletin* Committee does not have any additional information about either Mary C. or John Rabbitt or Clifford M. Nelson. If any HGS member has knowledge of the authors listed above, and would be willing to forward it to the *Bulletin*, we would be happy to publish it.

EDITOR

LETTERS TO THE EDITOR

The HGS *Bulletin* welcomes all "Letters to the Editor." All letters from this point forward must, however, be accompanied by the author's name and address.

MEETINGS

HAPL/HGS JOINT DINNER MEETING—JANUARY 22, 1991

MAX G. PITCHER—Biographical Sketch

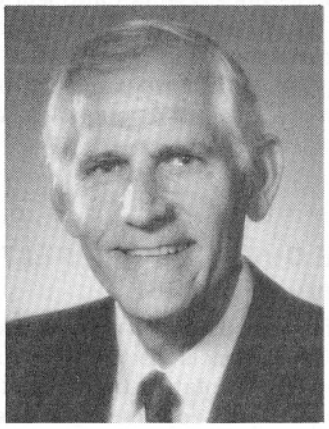


Photo by Gittings

Max G. Pitcher is executive vice president of worldwide exploration for Conoco Inc.

He received bachelor's and master's degrees in petroleum geology from Brigham Young University. After doing field geology in the Yukon and northern British Columbia, he attended Columbia University in New York where he received a Ph.D. degree in geology.

He joined Conoco in 1963 as a research geologist at Ponca City, Okla., and in 1965 was named director of geologic research.

He moved to Houston in 1968 as assistant to the executive vice president of exploration and production, and the following year was named Rocky Mountain division geologist at Denver. He returned to Houston in 1973 as chief geologist before being named vice president of North American exploration in 1976. He was named vice president of international exploration in 1986 and was named executive vice president of worldwide exploration in 1988.

He has traveled extensively throughout the world and has participated in many geological and exploration symposia on the USSR, Africa and North America.

Pitcher is a member of the American Association of Petroleum Geologists (AAPG) and currently serves on AAPG's Industry Liaison Committee.

EXPLORATION AND PRODUCTION OPPORTUNITIES IN THE SOVIET UNION

The Soviet Union is number one in both oil and gas production with about 12 million bbl of oil per day and more than 75 billion cu ft of gas per day. In proved reserves, it ranks sixth for oil and first for gas. Although published numbers for undiscovered reserves are not available, the USSR no doubt ranks first for both oil and gas. Of the 2,800 oil and gas fields in the Soviet Union, 182 are classified as giants (reserves of 100 million bbl or 600 BCF or greater). These facts, together with the present situation in the Middle East and the declining production and reserve base in the U.S., show why we need help from the Soviet Union. But why do the Soviets need our help?

Oil production in the Soviet Union has declined the last two years. This hurts exports to the West and reduces the availability of hard currency — at a time when internal economic problems have escalated dramatically. To try to alleviate some of the economic problems, capital has been diverted from the oil and gas industry to consumer goods, food and housing. Thus an already bad situation in regard to oil and gas has become worse. Equipment is in short supply, and much of it is old and in poor repair. Exploration and production technology lags behind that of the West. The funds to correct these problems and, ultimately, to increase production, must come from outside sources. Therefore, the Soviet Union is willing to work with non-Soviet companies. The environment is another concern. The Soviets, along with the rest of the world, have become much more aware of the environment and are demanding that problems caused by oil and gas development be corrected or prevented. Moreover, the Soviet Union has tremendous oil and gas resources in hostile environments similar to our North Slope. Our expertise is needed.

NOTE RESERVATION POLICY ON PAGE 2

The major oil-producing province in the Soviet Union is the West Siberian basin, which provides more than 60% of the USSR's oil production of 12 million bbl per day. This passive rift basin has a thick sedimentary sequence (15,000 feet or greater in places). The Volga-Urals region, a tensed foreland basin, produces 2.5 million bbl of oil per day. The Peri-Caspian is a modified rift basin which includes the supergiant Tengiz field. Its in-place reserves have been estimated at 25 billion bbl (6-7 billion bbl recoverable). Other oil and gas fields are in the Barents-Kara Sea area, Timan-Pechora and the Sakhalin basin. The Baku area, along the Caspian Sea, has produced oil since 1890. East Siberia is as yet a poorly known area in regard to hydrocarbon potential.

Joint ventures with the Soviet Union are not easy, and were not even possible until very recently. The first hurdle is finding the appropriate agency and/or person with the legal authority to make a deal. The government organization in the Soviet Union and the fifteen Soviet republics assures a lot of work along the way toward finalization of a joint venture. The economic and political changes now taking place, including the republics' demands for more control, complicate an already complex situation. Despite these hurdles, 1,300 joint ventures had been registered with the Ministry of Finance as of February 1990, but probably a third or less are operative. At this writing, only a couple of oil and gas joint ventures are operative, and they involve well stimulation and drilling. However, several announced oil and gas joint-venture efforts are expected to progress to the operation stage.

The Soviets need our equipment, technology and expertise. We need their oil. There are tremendous problems to overcome, but the huge opportunities make the risks worth taking.

HGS LUNCHEON MEETING—JANUARY 30, 1991

MICHAEL P. PRESCOTT—Biographical Sketch

Michael P. Prescott, president of Big M Exploration Inc., received his bachelor's degree in geophysics in 1969 and a master's degree in engineering management in 1973 from the University of Tulsa.

During his nineteen years in the oil industry, he held positions of exploration geophysicist, Gulf Oil Corp., exploration geophysicist, Getty Oil Co., and consulting geophysicist, R. Brewer and Co. In 1984, he founded Big M Exploration Inc. to concentrate on play and prospect generation. More recently, he has been involved in the generation of high potential natural gas prospects in south Louisiana.

The paper to be presented has received the GCAGS 1st Place Award as well as the AAPG's A. I. Levorsen Award.

THE MAURICE FIELD: NEW GAS RESERVES FROM BURIED STRUCTURE ALONG THE OLIGOCENE TREND OF SOUTHWESTERN LOUISIANA

Significant new gas reserves have recently been discovered in the **Marginulina texana** sands along the Oligocene trend at the Maurice Field. Detailed subsurface maps and seismic data are presented to exhibit the extent and nature of this local buried structure and to demonstrate future opportunities along the Oligocene trend.

Since discovery in 1988, the MARG. TEX. RESERVOIR C has extended the Maurice field one half mile south and has established 200 feet of **Marginulina Texana** pay. Estimated reserves are in the order of 160 billion cubic feet of gas with limits of the reservoir still undefined. This reserve addition would increase the estimates of the Maurice field by over 70 percent from 220 billion cubic feet of gas to 380 billion cubic feet of gas. Cross sections across the field depict the new reservoir trap as a buried upthrown fault closure with an anticipated gas column of 720 feet.

Interpretation of the origin of this local structure is that of a buried rotated fault block within an overall larger depositional structure. Detailed subsurface maps at the **Marginulina texana** and the overlying **Miogypsinoides** level are presented. These maps indicate that one common fault block, FAULT BLOCK AB, is productive from two different levels. The deeper **Marginulina texana** sands are trapped on north dip upthrown to a southern boundary fault, FAULT B. The overlying **Miogypsinoides** sands are trapped on south dip downthrown to a northern boundary fault, FAULT A. The northern fault, FAULT A, was the **Marginulina texana** expansion fault and rotated that downthrown section to north dip. Because of the difference in dip between the two levels, the apex of the deeper **Marginulina texana** fault closure is juxtaposed by one mile south relative to the apex of the overlying **Miogypsinoides** fault closure.

Analysis indicates that important structural growth occurred during **Marginulina texana** deposition with a local unconformity covering the apex of the upthrown fault closure. State-of-the-art reconnaissance seismic data clearly exhibit this buried rotated fault block. Similar buried structures are predicted to exist along the Oligocene trend. Such occurrences will open opportunities to explorationists for the discovery of significant gas reserves throughout the 1990's.

APGE EXPLORES THE OVERTHRUST BELT
Rice University, January 21, 1991

The January meeting of the Houston chapter of the Association of Petroleum Geochemical Explorationists (APGE) will be highlighted by a presentation by Dr. Matt Matthews entitled "**A Regional Microseep Survey of the Wyoming-Utah Overthrust Belt.**" This soil hydrocarbon survey clearly identified geochemical anomalies associated with Whitney Canyon, Ryckman Creek and other area oil fields. The technique used is one of the few tools that enables us to look directly at hydrocarbons and, as such,

provides the explorationist unique information to help reduce risk in frontier areas. Matt joined Texaco Exploration and Production Research in 1984 as a Senior Research Consultant, and has been involved with predictive stratigraphy, dynamic modeling, fractures, and unconventional exploration techniques. He received his B.S. from Allegheny College, MS from West Virginia U., and Ph.D. from Northwestern. He has been co-director of the industry side of the Geosat-NASA Test Case Program and director of the Oil and Gas portion of that study.

A REGIONAL MICROSEEP SURVEY OF THE WYOMING-UTAH OVERTHRUST BELT

A regional microseep survey of 1280 square miles of the Wyoming-Utah Overthrust Belt clearly identified anomalously high surface occurrences of light hydrocarbons associated with Clear Creek, Ryckman Creek, and Whitney Canyon-Carter Creek fields. The ethane-to-propane ratios of these anomalies are very similar to those of the hydrocarbons produced from the associated fields.

Ethane, propane and butane were well correlated on a per-sample basis, suggesting that they came from a single subsurface source (Lower Cretaceous). The poor correlation of methane with the other light hydrocarbons suggests that multiple sources of methane exist (Upper Cretaceous, higher maturity Lower Cretaceous, Phosphoria, and perhaps recent biogenic activity).

Anomalies were identified by calculating the percentage of samples, within a moving window, that are above the median for the complete survey and stacking the percentages for each light hydrocarbon to create a composite map. The technique smooths the spatial information and transforms the data from an unknown distribution into a binomial distribution. This permits statistical tests of significance which have been substantiated with Monte-Carlo simulations. The anomalies are both stronger and spatially more extensive than would be expected on a random basis.

This use of microseep data emphasizes the identification of broad areas of interest, rather than the direct identification of drilling locations often associated with surface geochemical surveys. These broad surface patterns must then be combined with available subsurface data to develop play possibilities.

This technique is one of the few tools that looks directly at hydrocarbons. It provides the explorationist unique information to help reduce risk in frontier areas. An example of this occurs in the Crawford Thrust. Conventional wisdom is that this thrust is gas-prone, arising either from thermally supermature Lower Cretaceous source rocks or biogenically produced in the Tertiary at the surface. However, anomalous concentrations of ethane and propane in the surface microseep data suggests the presence of an unsuspected source of wetter hydrocarbon in the subsurface.

ORIGIN OF GULF COAST OILS AND GASES
SEPM Announces a New Publication

The Gulf Coast Section of the SEPM has just published its long awaited volume entitled **"Gulf Coast Oils and Gases: Their Characteristics, Origin, Distribution, and Exploration and Production Significance."**

The technical papers included in this volume were presented at the Ninth Annual Research Conference of the GCS/SEPM held in New Orleans in December of 1988. The conference was convened by Deet Schumacher (Pennzoil) and Chuck Kennicutt (Texas A&M) and brought together most of the individuals working in Gulf Coast geochemistry and its applications, to exploration and production. Reviews of this conference have previously been published in the Oil and Gas Journal (7/17/89) and in the April 1989 HGS *Bulletin*.

The 33 papers and abstracts included in the Proceedings volume cover a wide range of topics and exploration/production applications including: the characteristics and origin of oil and gas in Jurassic, Cretaceous, and Tertiary reservoirs onshore and offshore; applications of geochemistry in development geology; hydrodynamics in south Louisiana; hydrocarbon seepage and related diagenesis; and quantitative modeling of hydrocarbon generation and migration.

Most of the papers in this volume present previously unpublished data and interpretations. These papers record the current views of a diversity of scientists on topics of great importance to explorationists and oil and gas producers in the Gulf Coast basin. Application of the concepts presented here should stimulate the formulation of more effective exploration and development strategies by providing a better understanding of the processes that have led to the formation and occurrence of Gulf Coast oils and gases.

This volume, edited by Deet Schumacher and Bob Perkins (UT-Arlington), has a sales price of $38.00 and is available from Earth Enterprises, Inc., in Austin, Texas (512-345-3007).

HAPPY NEW YEAR!

INTERNATIONAL EXPLORATIONISTS

Chairperson's Column

The international divisions of most major oil companies have been big money makers since oil became an important economic resource. As different international opportunities become available, companies shift priorities and funnel their resources to respond. The most important resource of any organization is their people. As we look around us, most of the attendees at the HGS International meetings are these people. The collective experience in the group is tremendous. You can find at least one person who knows something about a potential area in some remote part of the world. Where did these people come from? How did the companies develop them into experts? What are they doing now?

I have been involved in recruiting in the past few years and found it very refreshing and informative to be on campus and talk to students and faculty. The students are bright, enthusiastic about what they are working on, and excited about geology. And it is from this pool that we are drawing our future experts. The disconcerting thing is there are so few graduate students in geology. The enrollment has dropped drastically in most of the schools since 1986 with the oil crash. On top of this, those who are in graduate programs are generally skeptical about the industry and their future. To attract these students to our industry, recruiting efforts have become creative, innovative and very competitive. In this shrinking pool of students there is a resource that can be tapped: in most of the big name schools, the large percentage of graduate students are foreigners who come to learn the latest techniques in G & G and work with some of the famous personalities. Based on faculty comments, some of the brightest graduate students are in this pool. Although some of these students are planning to return to their native countries, some are looking for jobs in this country.

With shrinking graduate enrollment in geosciences, the "fresh blood" available each year is going to get smaller and smaller. This will continue till the next cycle in the oil industry. Yet, the resources of any company should be replenished each year. Creative and innovative exploration processes can continuously improve only by building on quality of experience and developing new experts in different topics and areas around the world.

PINAR O. YILMAZ
Chair, International Explorations Group

HGS INTERNATIONAL EXPLORATIONISTS COMMITTEE 1990-1991 MEETINGS

All meetings will be at **Westin Oaks Hotel** in the Galleria.

We will meet every third Wednesday of September to November and January to May, except for two months: **February 13 and March 6, 1991.**

NOTE RESERVATION POLICY ON PAGE 2

INTERNATIONAL EXPLORATIONISTS COMMITTEE MEMBERS 1990-1991

Chairperson & Technical Program:
Pinar Yilmaz, Exxon Prod. Res. Co. 973-3070

Hotel and A/V Arrangements:
George Tappan,
Geoservices International 358-4061

Tickets & Announcements:
Tom Tucker, Marathon Oil 629-6600

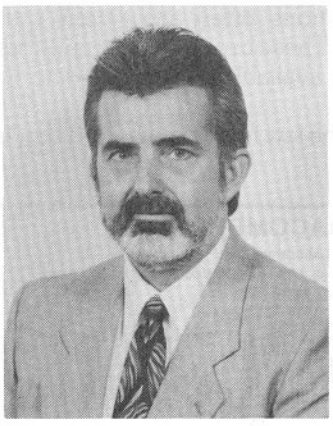
Finances:
Don Young, Petroval 783-1248

Membership:
Kumar Bhattacharjee,
Sita Oil Exploration House 999-6957

For ticket reservations call the HGS at 785-6402.

HGS INTERNATIONAL EXPLORATIONISTS DINNER MEETING—JANUARY 16, 1991

CARLOS A. DENGO—Biographical Sketch



Carlos A. Dengo is a senior research specialist with Exxon Production Research Company in Houston. He received his B.S. in geology in 1976 from Syracuse University, and his M.S. in 1978 from Texas A&M University. He continued at Texas A&M Center for Tectonophysics for his Ph.D., which was completed in 1982. Carlos was given the US National Rock Mechanics Committee award for the outstanding student paper in 1981. His dissertation is titled "Structural Analysis of the Polochic Fault in Western Guatemala, Central America."

Carlos Dengo started his professional career at Exxon Production Research Company in August, 1982, as a research geologist in Fracture and Seal Group. His research interests were on fault mechanics and deformation processes. During 1984-85, he worked for Esso Australia in

Sydney on structural styles and fault seals of the Gippsland Basin. On his return to Houston, Dengo studied tectonic and structural controls on source rock distribution. He was promoted to research specialist in 1986. For the next few years, his assignments with different Exxon affiliates included projects on structural styles of Guatemala; structural styles of Marathon-Val Verde Basin, Texas; and tectonics and trap styles of Barents Sea, Norway.

Carlos is actively involved in training Exxon G & G staff around the world in structural geology. He has authored numerous company research reports and published outside. He is an active member of AGU, GSA and AAPG.

STRUCTURE OF THE EASTERN CORDILLERA OF COLOMBIA: A TECTONIC MODEL FOR THE COLOMBIAN ANDES

The tectonic history and structure of the Eastern Cordillera is discussed with a view towards describing 1) trap styles and 2) a tectonic model that relates the Eastern Cordillera to the adjacent Colombian Andes and the entire orogen to the convergent plate margin in the Pacific. The northern Andes in Colombia comprise the Western, Central and Eastern Cordilleras, separated from each other by intermontaine basins. A regional balanced cross section across the Eastern Cordillera shows that uplift of the cordillera on high-angle, basement-involved reverse faults was preceded by thin-skinned deformation, which generated the majority of the structures present within the range.

During the Late Jurassic through Early Cretaceous, a graben system formed in the area presently occupied by the Eastern Cordillera. Late Cretaceous deposition in the region was part of a passive margin that extended across the northern and northwestern margin of South America. Paleogene tectonism along the western South American margin created a foreland basin that extended between the Central Cordillera and the Guayana Shield, including the Eastern Cordillera area. Compressional deformation began in the Eastern Cordillera in Miocene-Pliocene time, characterized by thin-skinned deformation on multiple detachment levels within the Cretaceous section. This deformation rooted in a deep, gently-dipping detachment that extends beneath the Middle Magdalena Basin and the Central Cordillera. Backthrusts splaying from this deep detachment verge west toward the Middle Magdalena Basin. Regional uplift of the Eastern Cordillera deformed belt occurred in Plio-Pleistocene time along basement-involved reverse faults, some of which are inverted Jura-Cretaceous graben-edge normal faults. Basement uplift occurred as strike-slip along the Santa Marta-Bucaramanga Fault was transferred to the Guacaraimo, Soapaga, Boyaca, and other reverse faults. Trap styles are fault-ramp folds that involve one or both potential Cretaceous sandstone reservoirs. Disharmonic folding of Cretaceous shales located between both reservoirs is commonly observed.

Based on a palinspastic restoration of the regional cross section, the amount of shortening across the Eastern Cordillera is about 40%, with 105 km of eastward-directed thrusting and 45 km of westward-directed thrusting. This shortening approximates closely that calculated by summing microplate motions for the northwest corner of South America. Shortening in the cover rocks greatly exceeds that for the high-angle basement-involved faults. The imbalance in shortening can be resolved with a deep, gently-dipping crustal detachment that extends beneath the Middle Magdalena Basin and Central and Western Cordilleras and which roots in the Benioff zone in the Pacific. The mid-crustal detachment model provides a structural link between the three Andean ranges; it provides a mechanism to transmit crustal shortening from the convergent plate margin to the Llanos foreland; it explains the eastward progression of deformation in both space and time; and, it implies that the Colombian Andes have been tectonically transported eastwards a minimum of 150 km.

INTERNATIONAL FEATURE

THE UK SECTOR OF THE NORTH SEA IS 25 YEARS YOUNG

By Philip Algar

The UK Minister of Power, Frederick Erroll, speaking in the spring of 1964, said that the first round of offshore licensing in the North Sea represented "a historic occasion of the greatest potential significance for the future of the economy."

Thus a politician was to prove more optimistic and accurate than many of the oilmen whose initial reaction was one of restrained optimism. Possibly influenced by unfulfilled expectations elsewhere, few voiced any bullish comments until well into the 1970s. Modestly more ebullient noises were coming from the specialist press, based, in part, on private remarks from some individuals in the industry.

By the early '70s, some oil company personnel maintained that total North Sea production could reach a peak of eight million barrels a day: fortunately, such thoughts remained private, although a maximum of a little more than half of that is currently very acceptable to Western Europe. However, the UK North Sea hydrocarbon quest, destined to be one of the most successful undertaken by the industry, was to shore up the economy, provide oil self-sufficiency for many decades, and yield exports that improve the balance of payments.

In 1964, "The Petroleum Information Bureau Commentary" captured the spirit of the times: "The cost of one exploratory well in the North Sea could easily be £1 million. There is no doubt whatsoever about the technical ability of the big oil companies to carry out such a project...It is safe to assume that neither money nor effort will deter the oil groups from the most thorough investigation of the new territory that legislation has brought within their reach."

Even after the spate of gas discoveries in the second half of the 1960s, in the southern sector of the North Sea, few companies expected any significant oil discoveries. One executive offered to drink every drop, and Sir Eric Drake, then chairman of BP, said in April 1970, that "there won't be a major (oil) field out there," but BP "had an obligation" to show themselves as explorers, and so work would continue. Four months later, the giant Forties Field was found.

The year 1964 now seems as distant as the year 2014. What was the background to the North Sea story?

1964 - The background

In 1964, UK interest rates reached seven percent, former UK Prime Minister Sir Winston Churchill made his last appearance in the House of Commons, and Harold Wilson became Prime Minister after winning the October election. President Lyndon Johnson vanquished Barry Goldwater and, in the Soviet Union, Kruschev was ousted by Brezhnev and Kosygin, while in Saudi Arabia, Faisal succeeded Saud as King. Another King, Martin Luther, won the Nobel Peace Prize and Nelson Mandela was imprisoned. China exploded the atom bomb and Japan staged the Olympic games in Tokyo.

"Petroleum Press Service" noted that "business sentiment in the U.S. has made a remarkable recovery from the shock of President Kennedy's assassination and Wall Street has clearly registered the general conviction that the business boom will go on." Oil demand globally was expected to rise by 1.5 million barrels a day, but the main worry was not the availability of the crude, but of the adequacy of the infrastructure. "The outlook remains clouded by product price weakness and by uncertainty about the concessions that may have to be made to producer governments."

UK gasoline prices rose from the equivalent of 24 pence per imperial gallon to 26.5p, following an emergency budget. (The 1989 price was around 180 pence). Coal provided about two-thirds of the UK primary energy demand of 168 million tons of oil equivalent (now 200 Mtoe), and the bulk of the balance came from oil imports, mainly from the Middle East, Libya and Venezuela. Saudi Light cost about $1.50 a barrel, and the average import cost was £6.89 per ton. Brent cost about $17.00 a barrel in 1989.

Although 1964 figures may seem trivial now, the UK was then confronted by economic problems. In particular, the import bill had to be cut, and anything which reduced the oil element was to be encouraged. This apparently permanent UK balance-of-payments sickness was to stimulate the development of offshore hydrocarbon resources over the next two decades, especially until self-sufficiency was attained.

1964 and the North Sea

In the 1950s, crude oil was inexpensive and plentiful, offshore technology and associated equipment were undeveloped and there was little geological justification for optimism on the presence of significant hydrocarbon deposits, onshore or offshore, around the North Sea. Knowledge of North Sea conditions was scanty and, in the absence of a reason, there was no agreed international boundary between the littoral states, all of whom were happy to import cheap crude from overseas. Indeed, there appeared to be no alternative. All this changed suddenly, when in 1958, after 13 years of exploration, Shell — in partnership with Esso — found a major gas field at

Reprinted with permission from **Petroleum Management**, Nov.-Dec. 1989, V. 11, No. 7.

partnership with Esso — found a major gas field at Groningen in the Netherlands. This promoted the view that hydrocarbons might be present in the North Sea.

Appropriately, in 1964, the UK, harried by the oil companies, was the 22nd country to ratify the UN Continental Shelf Convention, which thus came into effect. Events then moved briskly.

Even after the spate of gas discoveries in the second half of the 1960s, in the southern sector of the North Sea, few companies expected any significant oil discoveries.

In May, the Ministry of Power said it would grant licenses "to search for and get oil and natural gas in about 100,000 square miles of the North Sea." The press release, inviting applications for production licenses by July 20th, observed "the keynote in the words used by the Minister of Power, Frederick Erroll, in the House of Commons, is the need to encourage the most rapid and thorough exploration and economical exploitation of petroleum resources on the Continental Shelf."

The five factors that determined the initial, discretionary allocation of licenses are still familiar, in that they included, inter alia, "the programme of work of the applicant and also the ability and resources to implement it, the contribution the applicant has already made or is making towards the development of resources of our continental shelf and the development of our fuel economy generally," and "in cases where the applicant is a foreign-owned concern, (we shall consider) how far British oil companies receive equitable treatment in that country."

It was widely agreed that the regulations surrounding the award of licenses were astutely determined to ensure that the area would be assessed as rapidly as possible.

A total of 31 consortia applied for licenses and 22, comprising some 50 companies, were successful, being awarded 346 blocks covering 34,600 square miles. Shell-Esso, granted 75 blocks, covering more than a fifth of the total area, secured more than twice as many licenses as the next most successful consortium. Other operators included BP, Burmah, Mobil, Phillips, Gulf, Continental, Texaco and Total. Less familiar oil names, such as Whitehall Petroleum, Monsanto Chemicals and Rio Tinto Zinc were on the list of operators, as were Signal Oil, Home Oil of Canada, Placid and North Sea Selection.

"Petroleum Press Service" noted that the initial work programs called for the expenditure of £80 million over six years and that "this sum may well be significantly exceeded. On this indication, the combined enterprise of the various groups represents one of the largest ventures in the eventful history of the oil industry. The Board of BP, alone, has voted £5.25 million for future drilling operations in the North Sea...however...the ultimate outcome of the search is as yet quite uncertain and will remain so for at least another two or three years...even a single field may require several holes to be drilled until it is proved."

"The Esso Magazine" of spring 1965 sounded a similar cautionary note. "It is a sobering thought that the North Sea search for oil or gas will have to be measured in years, rather than in months. There will be no quick return on investment."

"Oil & Gas Journal" observed "Nobody knows whether king-sized oil or gas reserves are locked under the sea's choppy waters. Actual drilling has not yet started, but it will take more than a couple of dry wells to quench the exploration fever."

Although the winners were only named in September, the first exploration well was spudded on Boxing Day (Dec. 26), when the jack-up rig, *Mr. Cap,* began drilling in block 38/6, for Amoseas.

The first commercial oil found in UK waters was located by Amoco in 1969 and the legend, doubtless apocryphal, argues that the company was so surprised that oil was found it was forced to put it it in pickle jars, in the absence of more suitable receptacles.

The following year, 1965, saw the first gas discovery, by BP, and 127 new blocks were allocated in the second round. Unhappily, on December 27th, a year and a day after the first well was spudded, the first major accident occurred, when the *Sea Gem* jack-up rig capsized, drowning 13 of the 32 men on board. The North Sea would not be yielding its treasures peacefully. Now, 25 years on, we are commemorating the first anniversary of the Piper tragedy, in which 167 men were killed in the world's worst offshore disaster.

In 1966, Shell-Esso found the Leman Gas Field, and in the following year, West Sole, operated by BP, became the first gas field to go on stream. The first commercial oil found

in UK waters was located by Amoco in 1969 and the legend, doubtless apocryphal, argues that the company was so surprised that oil was found it was forced to put it in pickle jars, in the absence of more suitable receptacles. The giant Forties Field was discovered in 1970 and Shell-Esso located the huge Brent Field in 1971. Thereafter, oil and gas finds followed in swift succession, although hiatuses in exploration drilling, in the southern and northern sectors respectively, were subsequently provoked by low gas prices and high oil taxes.

Reaction and ruction

When the first North Sea oil came ashore in 1971, from the Ekofisk field in Norway, there was minimal media interest. A BBC radio program interviewed a Petrofina general manager, and Independent Television News dedicated ten seconds to the arrival. The first UK oil, from the Argyll field, was to arrive in 1975, with rather more attention. And self sufficiency, attained in 1981, was covered by a significantly more enthusiastic media.

Broadly, there was little real, wide-spread interest in North Sea activities until virtually the mid-1970s, despite the gas discoveries. Earlier, the main focus of attention had been on the social, not the economic aspects of offshore, and, because this was pessimistic Britain, on the problems that could occur. Even when it became apparent that the UK was to be a major oil producer, cynics dismissed the likely contribution as relatively unimportant, as West European demand was expanding so quickly.

The pessimism, perhaps fostered in part by the industry, reluctant to bolster hopes excessively, was neatly summarized by the Workshop on Alternative Energy Strategies study of 1977. "No further major discoveries are expected" in the North Sea, it stated. Such pessimism is an integral part of oil industry history: in 1910, the U.S. Geological Commission announced that there was no more oil in Texas and even in 1989, the UK government has only just conceded that self-sufficiency will be sustained to the end of the century.

Demonstrably, the North Sea industry has done more for the UK economy, for technology and for employment than any other sector since the war. Perhaps the words of William Bell, then a senior executive in Shell, commenting on the Brent Field in 1976, can be applied to the whole industry. "It is difficult to exaggerate the scale and complexity of the project or to pay adequate tribute to the accomplishment of all those involved."

Regrettably, it is a sad fact that much of the public comment on the industry over the last 25 years has been sour, and the history of the last two decades is littered with recriminations, rows and regrets.

This bizarre, masochistic attitude to the North Sea is best summarized by two examples. One leading UK industrialist, concerned that the rate of exchange, and thus his exports, would be damaged by North Sea crude oil exports, opined that "it might have been better to leave the *** stuff in the ground." A book on the industry, published in 1978, commenced with a chapter headed "Disasters, pollution and the environment."

Demonstrably, the North Sea industry has done more for the UK economy, for technology and for employment than any other sector since the war.

Once the taxation of the industry was determined, after a period in which rates levied were minimal, partly to stimulate the sector, the debate centered on what should be done with the unexpected government income. The administration's North Sea revenues peaked at £12 billion in 1984/5. This was equivalent to two-thirds of the revenue from value-added tax and a third of that from income tax. Peter Walker, who was subsequently Secretary of State for Energy, warned in a meeting at the Conservative Party conference in 1977 that oil revenue could become a curse rather than a blessing, if there was either an orgy of tax cuts or a massive public spending program. He went on to say, "the North Sea oil opportunity should be used to bring about two revolutions in British society: the regeneration of British industry so that the country will continue to prosper long after the oil runs out, and a sustained attack upon poverty and squalor and the scars which are still to be seen, particularly in our great cities."

Few would argue that either of these worthy objectives was even attempted, let alone attained: indeed, apart from paying unemployment benefits, much of the revenue has been invested overseas, which, while ensuring a steady income, has done little to modernize the British manufacturing industry, which suffered indirectly because of the inflated exchange rate caused by oil.

Leslie Pincott, the Esso managing director in 1976, warned that, although there might be enough oil revenue to "do all the things the most ambitious promoters of social improvement wanted," Britain would still face economic collapse unless the basic performance of manufacturing improved.

Eccentricity was not to be denied: even as late as 1977, a Scottish aristocrat was calling for North Sea oil revenue to be used to provide more golf courses and salmon fishing opportunities.

Under the spur of economic necessity, governments in the early days of the North Sea were obliged to ensure that exploration and exploitation was carried out as swiftly as possible. If this did not occur, the UK economy was destined to deteriorate significantly.

There was dissension. Political critics alleged that the agreement on international boundaries, accepted with alacrity by the UK, was unduly favorable to Norway. This hasty acceptance supposedly prevented the UK from claiming what was to become statfjord, Frigg and Ekofisk. Another subject of contention was that the allocation of blocks in the early rounds discriminated against the British companies. The validity of the production license, at 40 years, was too long, according to the Labor opposition in 1964, who argued that 10 years would be adequate. Some critics, notably Lord Balogh, maintained that during the development state, the oil companies were taxed too lightly. Once Forties and Brent had been discovered, it was claimed, the risk was reduced so the companies would not leave the sector.

UK manufacturing companies were not given a fair chance to provide services and equipment, according to analysts, while others maintained that they were too apathetic to take advantage of the burgeoning market on their own doorstep. A report produced by IMEG in 1972 advocated the setting up of the Petroleum Supply Industry Board. From this developed the Offshore Supplies Office policy of full and fair treatment for British companies in the supply sector. UK-based companies now win 80 percent or more of offshore orders.

State participation, ultimately relatively meaningless, came and went, after a great expenditure of energy, time and effort by government and industry, as did the British National Oil Corporation, and the row on whether the government should implement depletion policies. Shell described the moves to state ownership as a waste of taxpayers' money.

At different times, interested Scottish groups have challenged the legality of ownership of the oil off their coast and there has been the occasional difference of opinion on the role of the European Commission in UK North Sea oil.

Unhappily, the public, fed on a diet of popular newspaper headlines in the seventies, in which the word "bonanza" featured regularly, became accustomed to the concept, if not the reality, of cheaper fuel prices.

Gas prices would surely fall as the UK reached self-sufficiency and once the nation was converted to the new natural gas. The conversion itself promoted more heated arguments, in which the safety of the new fuel was challenged. Thirty-five million appliances at 13.5 million premises were changed at a cost of £1 billion.

As global crude oil prices rose in 1973-74, it was widely and erroneously assumed that UK gasoline prices would remain stable. Unfortunately, the industry and the politicians failed to convey adequately to the public the enormous costs involved in the North Sea, especially as near hyper-inflation overtook the price of many services and components.

Although crude oil prices rose again in 1979-80, thus saving some North Sea projects that otherwise might have proved uneconomic, the longer-run trend of prices was downward. The nadir was reached in the summer of 1986, when crude prices fell into single figures. Exploration ceased, projects were postponed and the industry reassessed virtually everything it did.

Inspired by the low price and the prospect of little real improvement for some years, the industry initiated new technology, improved design and management, and cut between 30 and 40 percent off the cost of new projects, which were also brought on stream ahead of schedule. The innovation is set to continue and costs can be cut further. This is becoming increasingly important, as the finds are now smaller than in the past. However, a combination of cost-cutting and the number of finds, many of which are located near existing infrastructure, surely bodes well for the sector. The UK will remain a major producer of oil and gas well into the next century.

So far....

By the end of 1988, some 1,300 exploration wells had been drilled in the sector, and more than 200 significant oil or gas discoveries had been made. Cumulative oil and gas production was, respectively, 1,190 million tons and 691 million cubic meters. Over 250 significant finds have been made and some 60 fields are in production, from which the UK government has secured £66 billion in revenue.■

Happy New Year from the HGS Bulletin Committee!

GEOTALES FROM FAR AWAY

DI-BAWAH POKOK!

(Under the Tree!)

By Paul R. Ashton

I put my hammer down, slipped the sack of samples off my shoulders and sat down on the caliche-covered limestone slab. It was noon, hot and humid, and I was hungry. The hill-top was about six miles from where I had left the jeep, with strict instructions to the driver to keep it in the shade and await my return at the end of the afternoon. I opened up some crackers and peeled a banana, making "sandwiches" that would be sufficient to keep me going until evening. Taking a swig of warm water from my canteen, I reflected on how I had come to be perched on a hilltop far from home...

Join BP as a geologist, and it went without saying that you would do fieldwork. There was, after all, a tradition to uphold, started by William Knox D'Arcy in 1901. He sent geologists into Persia to look for oil, and they remained there for seven years until oil was found, just as he ran out of money. According to the official company biographer, my predecessors toiled in "an inhospitable landscape without roads, without comfort, a bleak and baking place of empty hillsides and inescapable sun. The first site was Chia Surkh in the west. Drilling was carried on in appalling conditions: thousands of dead grasshoppers poisoned the stream that was the only source of water supply; thirst, dysentery and heatstroke plagued the men; and while some oil was found in 1903 and 1904, it was not sufficient to justify production."

During the early 1970s, BP remained strong in the belief that field geology was a tool whose time had not yet been passed over by the many and various remote-sensing techniques then coming on the scene. No doubt in an attempt to avoid hiring armchair geologists, the recruiting pamphlets of the late sixties indicated a love of the outdoors, with pictures of bearded field geologists in the Brooks Range of Alaska, Land Rovers in Arabia, and a lone intrepid geologist wading up a crocodile-infested creek in Papua New Guinea.

Looking for a life of excitement? Join BP as a field geologist!

Such an opportunity presented itself to me in 1970, and I took it for two reasons. First I enjoyed fieldwork, though my prior experience had mostly been confined to Western Ireland and Northern England. Second, there were very few other choices, the late 1960s being somewhat similar to the late 1980s in the level of graduate hirings. I had secretly hoped for cooler climates, preferably without snakes, but of course, the Chief Geologist knew better. In 1974 I found myself in Singapore, destined for fieldwork in Indonesia.

A few months earlier we had recommended a farmin to acreage held by Gulf on the South Arm of Sulawesi. Seismic had revealed what appeared to be a number of reefs. But these could also have been buried volcanos, so some fieldwork was considered a necessity. Seismic indicated that the possible reef platform might crop out along the southern edge of the basin. The plan was to check this out and see if a correlation could be made between the surface rocks and the seismic reflections. I was given the responsibility for this work, and was assigned another geologist, Martin Davies, to help me cover the ground. We were given four man-months of time and budget, and left to get on with it.

Researching the files, I noted the detailed planning that had gone into an earlier field survey on the island of Borneo. There the geologists had been so removed from civilization that they had learned how to do an appendectomy on each other (for anaesthesia, use the emergency rations of brandy; fresh urine is an excellent antiseptic, etc.). I was relieved to note that the area of my own fieldwork was somewhat less remote. I also received some interesting advice from a senior geologist who had spent time in Papua New Guinea. He always took along cans of caviar and other delicacies to relish each and every Sunday evening. In his words, "You can't afford to go native, you know".

Gulf remained the operator of the block, but had no interest in conducting fieldwork. Gulf did, however, provide local assistance, in particular from their base in Ujung Pandang, once known as Makassar. I later learned why Gulf had no desire to go to the field - an internal memo had been written some years previously which recounted horrendous conditions in the area, advising that there were "no places to

The Road from Ujung Pandang to Sengkang

stay, and all trips should be made out and back in one day".

Ujung Pandang is a major city, with a population of more than half a million people, and the same number of bicycles and tricycles. The latter, called *bechaks*, form the preferred taxi service, with the passengers seated precariously in front of the one man-power engine. The Dutch favored the city with many well built houses, a fort and a church. The fort overlooks the harbor, which remains to this day the home port of the Buginese Merchant Navy. The Buginese, unfortunately better known in the west as "Bogeymen", are among the proudest people in the region, having maintained a fearless tradition as the dominant traders between the thousands of islands that make up the East Indies. A fiercely independent group, the Buginese fought many wars with the Chinese, the Dutch and anyone else who tried to dominate their hold on trade (the most lucrative commodity being spices destined for Europe). Today, the inhabitants of Sulawesi are a smiling, curious people, but still very much aware of their proud heritage.

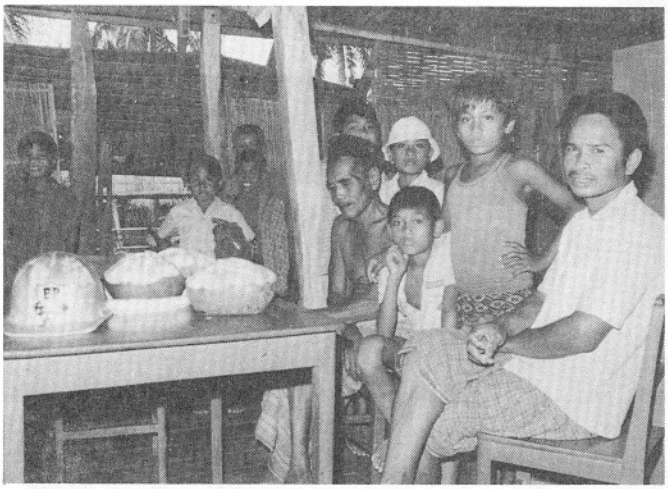
We flew in by DC-9 jet, a relatively new experience for those who would stand twenty deep at the airport fence waiting for the arrival of the daily service from Jakarta. At the airport we were met by Gulf's branch manager, a local accountant and expeditor, the sort of man you need when organizing the improbable in an impossibly short space of time. He in turn introduced us to our field crew, a foursome who were probably just as curious about us as we were about them.

Hassanudin was the leader. He would be our one field assistant, to be shared every other day. Hassanudin was a wild Buginese, with shoulder-length hair and a large silver ring on each finger. His name hailed from the famous Bugis warrior who had defeated all comers in the defence of the Buginese way of life. Our Hassan wielded a *parang* with the same dexterity as his namesake no doubt did when defeating the Chinese and Dutch invaders. He was fluent in both the national language and the Bugis dialect. Having worked for Gulf before, he could converse in English, and had learned the radio alphabet (Alpha, Bravo, Charlie, etc.) which he used to explain the spelling of village names not on the map.

Pieter was the cook. He clearly ate at least half of everything he prepared. Born on the island of Ambon, Pieter's Christian name reflected the strong influence of the Dutch missionaries on that community. A proud camp boss, Pieter was a born organizer. George, whose name seemingly had been borrowed from a Gulf expatriate, was a shy individual who would be driving one of the two Land Cruisers. Ali, who would become my driver, also appeared to be shy. An older man, he seemed to take life very seriously, unless, that is, it happened to be in the way of his jeep!

We drove into the city and spent the rest of the day stocking up on the best supplies the Chinese *Towkays* could provide, including cases of Danish ham, a strange commodity for a predominantly Muslim land. A large tarpaulin was located, and some folding lounge chairs for beds. Mosquito nets and several cans of Shelltox were purchased in the knowledge that every mosquito in the land would come thirsting after our blood. That night we spent our last evening under a solid roof, staying at Gulf's rest house, a large colonial-styled bungalow entirely furnished out of a Sears catalog. The next morning, the houseboy served breakfast at five-thirty, and we were on the road an hour later, driving north.

Indonesia is a truly amazing collection of islands, and Sulawesi must be one of the most beautiful. The scenery is rooted in the diverse geological framework of the island, which includes pieces of Asia, Australia and an ancient ocean floor. The ophiolite belt of eastern Sulawesi is one of the largest in the world, being a wedge of oceanic crust obducted onto Asian crust during the Middle Miocene. The relative youth of much of the tectonics is reflected in the high mountain ranges. These are surrounded by sedimentary basins, of which the Sengkang Basin, site of our exploration play, is one. But to reach Sengkang we would first cross the coastal mountains by a winding road that would take at least eight hours to traverse.



The villagers were always hospitable

The main road north from Ujung Pandang follows the coast to Pare Pare. But we soon struck inland on a poorly maintained blacktop road. The initial scenery consisted of a beehive karst topography carved into platform limestone that dipped west towards the East Java Sea. The road skirted this impenetrable area, but not before we stopped at an old Dutch spa famous for its swimming holes surrounded by clouds of rare butterflies.

The road then began to climb up a mountain pass. A graphic road sign, showing a crashed bus with bloodied passengers lying all around, warned of the dangers of fast driving. But no one seemed to take heed. At about four thousand feet we stopped at a rock overhang where a dolerite sill had proved too much for the builders of the road. Soon after, the road reached a plain where farmers grew rice amid cloud-covered ridges composed of volcanoclastic rocks.

As the road began to descend into a narrow valley, the topography changed, reflecting a drier climate. Kapok trees lined the road and the fields around the villages contained corn in place of rice. We were in a localized rain shadow.

As we approached our destination, a north-south ridge of very young sediments came into view. With dips of around fifty degrees, these strata indicated the youthfulness of the tectonic history of the area. Perched against this ridge is the city of Sengkang. To the west of the city these Pliocene-age beds dipped steeply into Lake Tempe, itself centered over a half-graben of Pliocene and Pleistocene sediments at least 20,000 feet thick.

We arrived before dark, and drove up to the old government rest house, perched on top of a hill. Rest houses were the one reason why the colonials could travel easily from town to town. It is clear that many of these rest houses have seen better days. Simple advice for future visitors and field geologists: do not eat the food, and don't use the bathroom. Better food could be found in the city, where a dirt-floored Chinese restaurant offered recognizable dishes like egg foo-yong and golden carp steamed in ginger. As for the bathroom, suffice it to say that the plumbing had never been connected on the other side of the wall! Perhaps that Gulf memorandum was not so far off the mark after all.

There was no doubt in my mind that a better base camp could be found far away from this stinking hilltop, and so the next day we set off towards the area to be mapped, following a road that quickly degenerated from blacktop to gravel, to

ruts, and to a broken culvert where a crew of laborers would not let us pass, until a few *merokok ingeris*, made by Benson & Hedges, were handed out. Even if you don't smoke, cigarettes have their uses as barter, or for killing leeches (but that's another story). A mile or so further on, the road started to improve, and eventually we came upon a village which was not on the map, but which was centrally located with respect to the task ahead. The government-appointed *kepala kampong*, or head of the village, approved of us, and showed us where we could set up camp. He also proudly led us to the village's centerpiece, an olympic-size swimming pool, built by the Dutch, located over a gushing fresh water spring. The village used the pool as their social gathering point. Fresh spring water, not unlike that which we buy in bottles at the supermarket, flowed with such vigor, all thoughts of disease and poor sanitation were washed way down stream. Could this be paradise?

A fence had to be built...

And so we began to unload the various supplies. The women from the village gathered around to stare and giggle. Later that day we had to build a fence to keep them at a distance. The men of the village took over the construction of camp. The large tarp was stretched over an elaborate framework of bamboo poles. Pieter set up his kitchen at one end, our supplies were stacked in the middle, and we would sleep at the other end. A total lack of walls to the tent gave us excellent air-conditioning, but no protection from driving rain and bugs.

By dusk we were installed, complete with fence, and we sat down to a feast of chopped ham cooked with rice and canned vegetables. For dessert, Pieter produced fried bananas. Carrying a couple of bottles of warm beer, I wandered off down the road to the village, and spent an interesting hour with the head of the village, before retiring for the night...

That was four weeks ago. As I gathered my things together before resuming my traverse across several ridges and valleys, the sun had already moved westward from its near vertical position in the sky. I realized I had better get going. But the afternoon proved most uneventful, with very few outcrops in the streams I had selected for the day's mapping. So at about four o'clock, I headed back to the track where I had left the jeep. When I got there, however, the jeep had gone. Ali was nowhere to be seen. I looked up and down the track, called out several times, and double checked that this was indeed the place where I had told Ali to park the jeep "under the tree". It certainly looked like the same tree.

Having been in the field alone all day, it being Martin's turn to have Hassan accompany him, I briefly resented the fact that for some reason we had not been able to have two assistants. I remembered stories about the "good old days" in Persia during the 1950s, when a geologist had up to thirty people to carry everything including the kitchen sink. So I tossed a coin and started walking to the south. After about half a mile I came to a village. Every single inhabitant came out to see the stranger; an event like this clearly didn't happen every day! Attempts at communicating broke down when it was realized that I didn't speak Bugis, and they spoke very little of anything else. Sign language ensued, from which it became clear that Ali and the jeep had not been this way. Ali must have driven off in the other direction.

But I could not take my leave as easily as I had come. The villagers, seeing my camera, wanted a group photo. Then they wanted to share some fresh young coconut water with me, which one of the village boys climbed to cut down from a tree. I had the feeling I might be staying the night; at least one father seemed to be thinking about what a good husband I would make for his daughter. But finally, as it began to get dark, I felt I could take my leave without offending their hospitality.

I walked back to the point where I had last seen Ali and the jeep. I walked about fifty yards further, and there was the jeep, wedged in a gully between two trees, with Ali fast asleep in the back. At once furious, I strode up the jeep and smote the canvas top with my map case. Ali jumped up, nervously smiling.

"O.K. *Tuan*, we go now?"

"Ali, why did you move the jeep?"

"*Tuan* said to keep jeep *di-bawah pokok*, under the tree and in the shade. When the sun moved, the shade moved, so I moved the jeep!"

I climbed aboard the jeep without a word, vowing that on the next day the jeep would be hot and uncomfortable. Ali was going to receive a new set of instructions!

Footnote: Fieldwork proved that the southern flank of the Sengkang Basin contained Upper Miocene algal reef mounds built on a platform limestone and overlain by Pliocene marls and shales. The platform limestone did indeed dip to the north and appeared to correlate with a strong seismic reflector. The next year four wells were drilled on separate reef prospects. Three found significant reserves of gas. These discoveries have yet to be developed, for lack of a local market and/or demand for liquified natural gas exports.

About the writer: Paul Ashton is a petroleum consultant based in Houston. He graduated from Southampton University, England, with a Ph.D. in 1970, and joined British Petroleum as a geologist. After leaving BP in 1977, he joined Cities Service Company, coming to Houston in 1980. In 1987 he started out as a consultant specializing in international exploration and economics, and subsequently also took on the sole U.S. distributorship of the Seistimer© seismic digitizing system.

ENVIRONMENTAL/ENGINEERING GEOLOGISTS

HGS ENVIRONMENTAL/ENGINEERING COMMITTEE BUSINESS MEETING JANUARY 9, 1991

Location: Charlies Hamburger Joint
2222 Ella Blvd.
just south of the 610 North Loop

Time: 6:30 - 8:00 p.m.

VICTOR T. JONES, III—Biographical Sketch

Victor T. Jones earned a Ph.D. in Physics (1969) from Texas A&M University. Dr. Jones is currently President of both Leak Search, Inc., and its parent company, Exploration Technologies, Inc.

Dr. Jones has directed over 200 environmental impact evaluations over underground gas storage areas which involved both the detection and location of problem areas.

As Director of Geochemical Application for Gulf Research and Development Co., Dr. Jones has worked with clients, both within Gulf and with other major oil companies, in designing geochemical exploration programs for field operations throughout the world.

His experience in geochemical exploration includes data processing and integration of most disciplines within the major sedimentary basins throughout the world. He has generated over one hundred (100) proprietary geochemical interpretation reports on the geochemistry of both onshore and offshore basins in the United States and many foreign areas, including South America, Africa, and the Far East.

Dr. Jones is a member of American Association of Petroleum Geologists, American Chemical Society, American Institute of Chemists (Fellow), Association of Petroleum Geochemical Explorationists, European Association of Organic Geochemists, Houston Geological Society, National Water Well Association, and Texas Water Well Association.

APPLICATIONS OF SOIL GAS GEOCHEMICAL METHODS IN THE DETECTION OF UNDERGROUND CONTAMINATION

The oil exploration industry has developed soil gas geochemical survey methods which are capable of predicting whether or not an undrilled subsurface prospect is more likely to contain oil or gas. This methodology focuses on the detection of light C1-C4 and C5 plus gasoline range hydrocarbons in the near surface soils, and the fact that the chemical composition of the gases that migrate to the surface from these reservoirs change in direct response to the inherent differences in these oil versus gas reservoirs.

Refined petroleum products also exhibit similar differences in the chemical makeup of their light and gasoline-range hydrocarbons. The volatile gases contained in all types of petroleum products, whether refined or natural, migrate easily from the shallow depths where these products accumulate whenever they escape from their man-made storage containers. Gas chromatography is utilized to characterize and quantify any contamination present in near surface soils and/or groundwater.

Numerous application examples will be shown where these methods have been successfully used to map the unknown extent of subsurface contamination from salt dome storage caverns, mined drifts, underground coal gasification reactors, leaky well casings, pipelines, and underground petroleum storage tanks.

The ability to determine hydrocarbon compositions, in addition to magnitudes, has often led to the identification of additional products not originally thought to be a part of the leakage problem. Major natural gas leaks have been identified, repaired, and separated from leakage associated with other types of subsurface sources. Soil gas methods have been used to define specific leakage products and their migration pathways. Leakage plumes are mapped utilizing the various volatile organic vapor data obtained from laboratory analyses. Although applications to hydrocarbon products are the most common, soil gas methods have and can easily be applied to other volatile organics, such as methylene chloride, Freon acetone, TCE, or any product having adequate vapor pressure.

Plume maps constructed using soil gas data are actually more accurate in defining the horizontal extent of contaminants than are the limited number of boreholes normally deployed. In fact, the soil gas plume maps are invaluable in determining the placement of core borings and monitoring wells which are required to determine the vertical extent of the contamination and the actual concentrations of the contamination at depth. A proper study should use both of these excellent tools employed in concert.

HOUSTON AREA LEAGUE (HAL)-PC USERS GROUP

Artificial Intelligence Special Interest Meeting
January 17, 1991 - 1200 Post Oak - 7:00-9:00 PM

DIRECT-CURRENT (SURFACE) ELECTRICAL RESISTIVITY HYBRID EXPERT NETWORK FOR GROUNDWATER MODELING

This network will process and interpret Schlumberger array of surface electrical resistivity data. Resistivity testing can locate groundwater aquifers. It can be used for salt water intrusion problems and other groundwater contamination situations. The network also contains a series of programs for simulating flow, mass transport, and heat transport in groundwater. The program handles various types of aquifer systems including well, source, and mine conditions.

HGS SHORT COURSE

ENVIRONMENT & ENGINEERING SECTION CONTINUING EDUCATION COURSE

COURSE TITLE: "Introduction to RCRA/CERCLA Environmental Regulations"

INSTRUCTORS: RCRA will be taught by William S. Stevens.

William S. Stevens D.E., P.E., P.G., is a principal partner in ERM Southwest, Houston, Texas. Bill received his B.E.S. in engineering from Texas A&M in 1976 and an M.E. in agricultural engineering (1978) and D.E. in engineering (1980) from the same institution. Bill has been involved with the application of RCRA from its earliest stages. He has over eight years of experience with the various aspects of federal and state environmental regulations. He has applied them to hydrogeologic characteristics, site assessment, remedial alternatives and action programs. He has handled many projects related to the treatment of high-level radioactive, toxic and hazardous wastes.

CERCLA/SARA will be taught by Helen Sadik-MacDonald.

Helen Sadik-MacDonald holds a B.A. in geology from the University of Texas at Austin. She is a hydrogeologist currently on staff of International Technology. Helen has spent the last three years working on RCRA and CERCLA sites at all levels and facets of their applications. Before joining the environmental industry and using her talents as a hydrogeologist, Helen had put over eight years in the oil industry (domestic and foreign) and with the U.S.G.S. She is an active member of the environmental section of the HGS.

DATE & LOCATION: RCRA: Tuesday, February 26, 1991
CERCLA: Wednesday, February 27, 1991
Paul Revere Middle School Auditorium
10502 Briar Forest (near Bltwy. 8)

TIME: 6:30 - 9:30 P.M. **COST:** $10/course or $15 for both

For further information call Zubair N. Haq (495-9828) or Nancy Boschetto (869-0455).

ENVIRONMENTAL NOTES

ARE WE CLEANING UP?*

Editor's Note: The following article is an excerpt from an Office of Technology Assessment (OTA) report evaluating the success of the Superfund Program. Two case studies were selected from the report to represent a successful and an unsuccessful Superfund Project.

Are we cleaning up the mess or messing up the cleanup? In the eighth year of Superfund, this central question is still being asked. This report examines two fundamental questions about using technology to clean up toxic waste sites. *First,* is the Superfund program consistently selecting permanently effective treatment technologies which, according to SARA (Superfund Amendments and Reauthorization Act), are preferable because they reduce "toxicity, mobility, or volume" of hazardous wastes? The answer OTA finds is that it is not.

Second, are land disposal and containment, both impermanent technologies, still being frequently used? The answer we find is yes. Future cleanups are likely for the wastes left in the ground or shipped to landfills.

The Superfund program promised a lot. People's expectations have been high, perhaps too high for such a new, complicated, large-scale effort. Frustration often makes it difficult to see real Superfund accomplishments. Since its inception at the end of 1980, Superfund has received a great deal of money, over $5 billion so far, to clean up the Nation's worst toxic waste sites. But OTA's research, analysis, and case studies support the view shared by most observers — including people in affected communities and people in industry paying for cleanups — that Superfund remains largely ineffective and inefficient. Technical evidence confirms that, all too frequently, Superfund is not working environmentally the way the law directs it to. This finding challenges all those concerned about human health and the environment to discover what is wrong and fix it. Whether Superfund will work cost-effectively over the long term depends on how cleanup technologies are evaluated, matched to cleanup goals, selected, and implemented and how permanent the cleanups will be. People want *their* cleanups — the ones they live near or pay for — to last. Improving public confidence in Superfund can be approached from different directions, including the one taken in this report: making better decisions about cleanup technology.

Too much flexibility and lack of central management control are working against an effective, efficient Superfund program. EPA Regions, contractor companies, and workers have substantial autonomy. In principle, flexibility can lead to benefits. But the case studies show the Superfund program as a loose assembly of disparate working parts; it is a system of divided responsibilities and dispersed operations. There is no assurance of consistently high quality studies, decisions, and field work or of active information transfer. The need for cleanups, the newness of the technological challenge, and the growth of Superfund mask the inexperience and mobility of the work force. Program managers have not offset inexperience in technical areas and management with tight management controls and intensive educational programs for government and contractor workers. Over-simplified "bean counting" of results instead of evaluations of what those results mean technically and what they accomplish environmentally provides too little incentive for quality work. The current decentralized system also does not assure higher levels of *program* efficiency over time, even though some workers and offices may become much more effective and efficient.

A widespread belief among Superfund workers is that "every site is unique." There is a kernel of truth to this belief. Yet uniqueness has been carried to an extreme and has blocked understanding of common site characteristics, common cleanup problems, common solutions, and common experiences with site studies and decisions. Identifying these commonalities is necessary to understanding how Superfund is being implemented nationally and understanding how to improve the program. At the beginning, when only a few cleanups were addressed, sites looked very different from each other. Now, with hundreds of cleanups examined, it is easier to see the commonalities and to benefit from the experiences to date. The case studies discuss similar experiences at various Superfund sites and help illustrate the link between identifying commonalities and achieving consistent cleanups.

"By understanding the capabilities of different cleanup technologies, it is easier to understand how compromises between cost and environmental performance can lead either to 'gold plated' or 'band-aid' cleanups."

Cleanup costs are major issues in the case studies. In site cleanup decisions, many people in government and industry want to keep costs as low as possible. Hence, there is a tradeoff between environmental protection goals (How clean is clean?) and the cost of the remedy selected (Is it cost-effective?). There is also a tradeoff between effective cleanup at some sites versus no action at others. These tradeoffs are getting more difficult as more and more sites requiring cleanup are identified. SARA's *preference* for permanently effective treatment technologies — not a requirement that they always be used — makes these

*From the Office of Technology Assessment (OTA) booklet "Are We Cleaning UP? 10 Superfund case studies," Special Report OTA-ITE 362, June 1988.

tradeoffs even harder; it also places more importance on the accuracy of cost estimates and on evaluations of the permanency of different cleanup technologies. By understanding the capabilities of different cleanup technologies, it is easier to understand how compromises between cost and environmental performance can lead either to "gold plated" or "band-aid" cleanups.

CASE STUDIES

The following are two cases selected from the OTA report. The first case, Love Canal, is considered to be a successful Superfund project while the second, Crystal City Airport, is considered a failure.

Love Canal, City of Niagara Falls, New York

EPA Region 2; NPL #142/770; estimated cost, about $30 million. — The ROD (Record of Decision) of 10/26/87 altered an earlier decision at Love Canal to use onsite land disposal for dioxin contaminated sewer and creek sediments. Now, a mobile thermal destruction unit will be used onsite to destroy and remove dioxin with an efficiency of 99.9999 percent. The cost for treatment will be twice that for land disposal, but the ROD selected thermal destruction on the basis of its ability to meet statutory requirements by eliminating toxicity and mobility. In addition, several site demonstrations elsewhere had successfully destroyed dioxin-contaminated soil with mobile thermal destruction units. EPA responded to extensive community comments against landfilling the contaminated material onsite and also decided not to attempt to separate materials with less than 1 part per billion dioxin (EPA's cutoff for acceptable contamination) because of uncertain reliability in doing so.

Crystal City Airport, Crystal City, Texas, EPA region 6

Capsule OTA findings. — Excavation of contaminated soils and wastes (which were buried in a previous removal action) and their disposal in an unlined landfill with a cap over it were selected over incineration. No treatability study supported the conclusion that the selected remedy is permanent on the basis of the adsorption of diverse contaminants to site soil. Major failure modes for the landfill were not examined.

Brief description of site. — "The site is comprised of approximately 120 acres of land. Surrounding the airport property...is land used for grazing animals...a municipal landfill...an elementary and high school as well as a residential area...Since 1949 the city has operated the facility as a municipal airport. Several private companies conducted aerial pesticide applicating businesses at the airport until 1982."

Major contamination/environmental threat. — "The estimated volume of contaminated soil exceeding 100 parts per million (ppm) total pesticide is 12,000 cubic yards." Although a large number of contaminants have been detected, "The contaminants of greatest concern at the site (toxaphene, DDT, and arsenic) were chosen from the compounds detected based on their wide-spread distribution over the entire site as well as the relative toxicity and concentration." There are also buried materials from an earlier removal action and contaminated buildings. Direct contact, surface water, and air emissions are major routes of exposure. The worst case exposure scenario is for residents of a nearby housing project.

General conclusions. — No sound technical case supported the conclusion that containing the wastes onsite constitutes a permanent remedy according to the intent of SARA. All of the contaminants may not bind tightly to the site soil, relevant regulatory requirements will not be met, health risks may be greater than normally acceptable levels, and a number of major failure modes of the containment system were not examined.

The cost of the incineration alternative was over estimated because of the residual arsenic contamination in the ash. In fact, stabilization of such a contaminant has been successfully demonstrated and is relatively low cost; biological treatment is also known to be feasible. The advantages of incineration over the selected remedy for the organic contaminants were discounted. **Moreover, in comparison to the decision to use mobile incineration at other sites with nearly identical types of pesticide and arsenic contamination, the negative view of incineration at Crystal City Airport seems inconsistent and even contrived.**

Since incineration is proven for the organic contaminants at the Crystal City site and provides better overall protection than consolidation/capping — contrary to the ROD's claim that the two choices are equal — a cost-effective remedy was not chosen. **The justification used by EPA for picking incineration at one site, in terms of its greater benefits over land disposal, particularly regarding permanency of remedy, undercuts the evaluation by EPA at Crystal City Airport.**

OTA's report concludes that in the cases evaluated, the lack of consistancy and permanent solutions in remedial actions have caused the Superfund projects to occasionally fail. This has been the result of too much inability and a lack of centralized MANAGEMENT in the Superfund program. The most successful projects have been characterized by careful, cost effective, well managed feasability and remedial studies.

ENVIRONMENTAL LAW SYMPOSIUM

South Texas College of Law will sponsor an **"Environmental Law Symposium"** in Houston on January 17-18, 1991 aimed at professionals such as corporate managers, governmental employees, engineers, scientists, and attorneys concentrated in environmental matters. The Symposium will address issues including underground storage tanks, water rights in Texas, asbestos contamination, technology remedies for Superfund sites and disposal of radioactive and other special waste. The Symposium will also offer professionals a chance to network and discuss common concerns at a reception following the first day of the program. For more information, call Michelle Coston at (713) 659-8040, ext. 305.

PERMIAN BASIN/MID-CONTINENT EXPLORATIONISTS

Permian Basin and Mid-Continent Exploration Meeting Thursday, January 15, 1991 6:00 p.m. - Westin Oaks

The January dinner meeting of the Houston Geological Society Permian Basin and Mid-Continent group will feature an A. E. Levorsen Award paper by Mr. J. Reed Lyday. A directory of the committee members and attendees of the 1990 meetings will be available. Membership applications will be available for attendees wishing to join HGS and interest survey forms will also be available for those who would like some input toward the content of future meetings or to work with this committee.

Our dinner speaker, Mr. J. Reed Lyday, will present his 1985 A. I. Levorsen Award paper; "Berlin Field: Genesis of a Recycled Detrital Dolomite Reservoir, Deep Anadarko Basin, Oklahoma."

Reservations must be made by Friday, January 11, 1991, by calling Margaret at Houston Geological Society (785-6402) before 4:00 p.m. Dinner is $20 for HGS members and $22.00 for nonmembers, no-shows will be billed.

BERLIN FIELD: GENESIS OF A RECYCLED DETRITAL DOLOMITE RESERVOIR, DEEP ANADARKO BASIN, OKLAHOMA

The Berlin Gas Field in Beckham County, Oklahoma, was discovered in 1977 and is the largest Atoka (Pennsylvanian) hydrocarbon accumulation in the Anadarko Basin. It is an overpressured reservoir 15,000 feet deep and occupies a surface area of 41 square miles. The reservoir rock consists primarily of recycled, detrital Arbuckle Dolomite (Cambrian-Ordovician), and contains ultimate recoverable reserves of 362 BCF.

Arbuckle Dolomite and limited exposures of Precambrian granite rocks were eroded from the Amarillo-Wichita mountains during the Atokan Age and were deposited as a terrigenous, sandy dolomite clastic wedge adjacent to the uplift. During late Atokan deformation, the Elk City structure was uplifted and subaerially exposed in the vicinity of the limit of the dolomite clastic wedge. The detrital dolomite on the structure was concurrently eroded and recycled basinward as a shallow marine fan delta. Recrystallization during burial diagenesis destroyed the detrital depositional texture and created the present intercrystalline porosity.

The deep Elk City structure consists of an upthrust block bounded by the late Atokan unconformity which is genetically associated with the Berlin fan delta. The present relief on the upthrust block and overlying anticlinal folds was formed during post-Atokan growth of the structure. The Elk City field contains roughly 1 TCF ultimate recoverable reserves in Springer, Morrow, Atoka and Des Moines strata.

The genetic relationship between the Berlin Field and Elk City crestal unconformity is an example of the possible association of crestal unconformities and clastic stratigraphic traps. Such stratigraphic traps originate in marine environments proximal to active structures that have become subaerially exposed. With adequate seals and favorable structural position, detrital deposits recycled from local uplifts can form significant stratigraphic traps which can occur in compressional, and diapiric regions.

NOTE RESERVATION POLICY ON PAGE 2

CALL FOR PAPERS for the RMAG 1992 Symposium on "Geological Aspects of Horizontal Drilling in Western North America"

The Rocky Mountain Association of Geologists is now soliciting papers for a ground-breaking volume on the geologic factors that affect the success of horizontal drilling. The book will be published in the fall of 1992. The emphasis will be on field experience and case histories in western North America. There also will be a place for more theoretical studies. The editors are looking for papers of three types:

1. Case histories and field experiences with horizontal drilling anywhere in western North America. The emphasis should be on the geological factors that influenced the

success or failure of the project. To illustrate the scope of the volume, examples of the formations and areas of interest include the Bakken Formation of the Williston basin, the Austin Chalk of Texas, the Niobrara Formation of the central Rocky Mountains, reservoirs on the North Slope of Alaska, the Weber Formation of northwestern Colorado, the Tertiary and Cretaceous coals of the Rocky Mountain basins, the Mancos Shale in western Colorado, the Mowry Shale of the Powder River basin, and the Tertiary heavy oil beds of southern California.

2. Papers on geologic principles and methods that affect horizontal drilling. These can cover such topics as physics and fractal analysis of fracturing, modeling and prediction of non-fracture reservoir heterogeneities, prediction of drilling problems, and core-log-seismic and remote-sensing analyses of fracture patterns.

3. Papers covering reservoir engineering, economic, legal, land, regional geology, or historical aspects of horizontal drilling plays.

Abstracts of 250 words or fewer should be submitted by February 15, 1991.

James W. Schmoker
U.S. Geological Survey
Mail Stop 960
Denver Federal Center
Denver, CO 80225
(303) 236-5794

Please call Jim Schmoker if you have any questions.

HGS FIELD TRIP REGISTRATION FORM

NAME: _____

ADDRESS: _____

_____

PHONE (home) _____

PHONE (work) _____

Check appropriate boxes for registration.

☐ NASA, Johnson Space Center and Lunar & Planetary Institute

☐ Introduction To Geoscience Workstations

☐ The Arbuckle Mountains

Enclose check payable to HOUSTON GEOLOGICAL SOCIETY.

Return with this form to:
Houston Geological Society
7171 Harwin, Suite 314
Houston, Texas 77036

OPINION

THE ENVIRONMENT AND THE NINETIES

By James C. Patterson

At the risk of adding to the cliches that have been written about the importance of environmental protection to our future survival, there is no doubt that the Nineties will be the Environmental Decade in this country and around the world. In one public opinion poll after another, the American people have said they are ready to begin protecting the environment, even if it means a slight economic slow-down and a few more cents out of their pockets. And countries in both the East and West are coming to recognize the necessity of protecting our planet.

The recent crisis in the Middle East seems to have had little effect on this environmental concern and the resulting proliferation of government regulations. In fact, recent increases in the prices of oil and gasoline have added "war profiteer" to our industry's "anti-environmental" image. Despite serious efforts by our industry to improve its public image during the past 10 to 15 years, an event beyond our control has rekindled the old negative feelings that arose during the energy crisis years of the Seventies. It is clear that we still have a long way to go toward convincing the public that we are not the oil barons of old, with a concern only for the bottom line and nothing but disdain for public opinion and welfare.

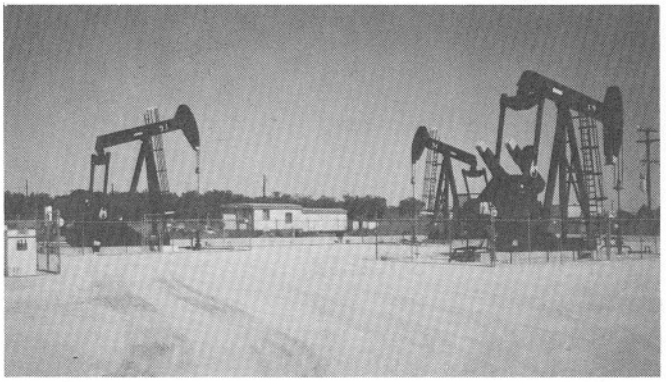
How do we go about making even modest positive changes in this public perception? While it is doubtful that our industry will ever be universally perceived as one of the "good guys," there are things that we can do to move in that direction. For example, as we work to influence the making of laws and regulations by local, state and federal governments, we must look for the solutions that are morally right, and not just those that are financially beneficial. And we must work to influence the opinion leaders, such as environmental groups and the media, that are highly visible and influential throughout the country.

These are tall orders by themselves, but we can't stop there. We, as an industry, also must clean up our own backyards. This includes updating, revising and implementing plans and procedures for cleaning up oil spills and restoring any damage done by even small oil and brine spills. We, as an industry, need to involve our neighboring communities in our environmental and safety planning and audits. This can be done through community advisory councils, which do not tell us how to run our businesses, but rather how to be more aware and understanding of their concerns.

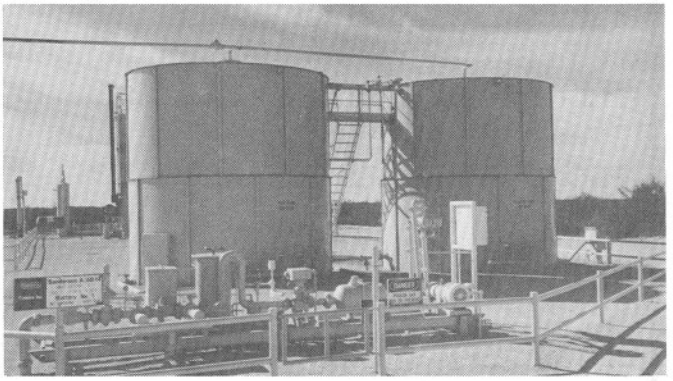
Our industry needs to promote its ability to manage waste to other businesses in the community. In addition, we need to spend money fixing up our own properties: painting, graveling roads and improving the overall appearance. This does not mean they have to be pretty, but they do need to be neat and well-maintained (see photographs). There are many benefits that may be derived from having a safe, clean, orderly and environmentally responsible workplace for our employees.

Our industry has a good story to tell, and everyone needs to be involved in telling it — not only general managers and vice presidents in the headquarters, but also the pumpers and roustabouts in the field, and everybody in between. Many times, enthusiasm and plain talk from our employees makes more of an impact than a lofty title.

There are some who might say that we don't need to convince the communities in which we operate because they are already on board. While this may be true in many instances, it is true because we haven't taken these communities for granted; we have tried to keep these communities informed and involved. And, we must continue to do so because it is this kind of grassroots communication



Tank batteries in the Odessa, Texas, area.



Tank batteries in Maljamar, New Mexico

that is vital to moving our industry in the direction of the more positive image that we are seeking.

But this isn't something that can be accomplished by one company alone. It is going to take the enthusiastic participation of everyone. This is the challenge that we face in the Nineties.

JAMES C. PATTERSON—Biographical Sketch

James C. Patterson (Jim) is Vice President, Exploration and Production, North America for Conoco Inc.

His working career commenced in 1952 with employment by the National Geophysical Company as a geophysicist. In 1954, he joined Conoco Inc. and was assigned to work with company-owned and operated seismic field crews. During the next 5 years he advanced to the position of Party Chief.

He was promoted to the position of Division Exploration Manager in Los Angeles with responsibility for exploration in the western states and Alaska.

In 1964, he transferred to Conoco's International Exploration Department, then headquartered in New York City, with responsibilities for overseeing the acquisition processing and interpretation of marine and land seismic data. During the 4 year period devoted to this type of work, over 50% of his time was spent outside of the United States.

In 1968, he worked as Assistant to the Vice President of International Exploration, followed by transfer to London in 1969, with responsibilities for exploration activities in Europe and Northwest Africa.

In 1973, he was promoted to Exploration Manager and remained in this position until 1978, when he transferred to Cairo, Egypt as Executive Vice President and General Manager.

After a short assignment in Egypt, he returned to London as Managing Director of Exploration. He remained in this position until 1980, when he was transferred to Houston, Texas as General Manager of Exploration for Conoco's International Operations.

On December 1, 1986, he was promoted to Vice President of North American Exploration in Houston, Texas, where he was responsible for onshore and offshore exploration.

On December 1, 1988, he was transferred to the Position of Vice President of Worldwide Exploration Technology and Development and North American Exploration.

On December 1, 1989, he was transferred to the position of Vice President, Exploration and Production, North America.

He is a native of Arkansas and he holds degrees from the University of Arkansas and Northwestern University. He is an active member of the S.E.G., A.GU., G.S.H., H.G.S., A.P.I., and has served as vice chairman of the P.E.S.G.B.

SEPM HONORS OUTSTANDING GEOSCIENTISTS

The SEPM recognized a number of outstanding geoscientists at an awards dinner at its recent Annual Meeting in San Francisco. James Lee Wilson received the Twenhofel Medal, the highest award of the Society, for sustained excellence in outstanding contributions to sedimentary geology. Honorary Membership in SEPM, the Society's second highest honor, was awarded to Raymond L. Siever, who has demonstrated excellent professional achievement and extraordinary service to the Society. Daniel J. Stanley was awarded the Francis P. Shepard Medal for outstanding research contributions to marine geology. William A. Cobban received the Raymond C. Moore Medal for a significant record of outstanding contributions in paleontology.

Allan P. Bennison was awarded the distinguished service award for his generous and enthusiastic support of geology, geology students, geological societies (including SEPM), and their publications.

The award for Outstanding Paper in The *Journal of Sedimentary Petrology* (Vo. 58) was awarded to David W. Houseknecht for "Intergranular Pressure Solution in Four Quartzose Sandstones." The award for Outstanding Paper in *PALAIOS* (Vol. 3) was awarded to Stephen M. Rowland and Roland A. Gangloff for "Structure and Paleoecology of Lower Cambrian Reefs."

Awards for Excellence of Presentation at the 1989 Annual Meeting were given in two categories. William W. Hay received the award for Oral Presentation. Jeremy Jamison received the award for Poster Presentation.

SEPM is an international society of sedimentary geologists that promotes a synergistic approach to understanding earth history through integration of physical, chemical and biological subdisciplines of earth sciences. Founded in 1926, it currently has over 5,000 members from academia, industry and government organizations.

JAN. CALENDAR of EVENTS 1991

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
		1	2	3	4	5
6	7	8 AWG Dinner Cathy Lee Farmer Village Cafe	9 **HGS ENVIR/ENG DINNER MEETING** **Dr. Victor Jones** **Charlie's Hamburger**	10 SPWLA Westside Luncheon	11	12
13	14 GSH Noon Luncheon	15 **HGS PERMIAN DINNER MEETING** **Reed Lyday** **Westin Oaks** SPWLA Galleria Luncheon	16 **HGS INT'L EXPL DINNER MEETING** **Carlos Dengo** **Westin Oaks**	17 **HGS ENVIR/ENG SHORT COURSE** SIPES Luncheon Bulling & Olsen Petroleum Club SPWLA Greenspoint Luncheon	18	19
20	21	22 **HAPL/HGS DINNER MEETING** **Max Pitcher** **Westin Galleria** SPWLA Downtown Luncheon	23 SPE Gas Technology Symposium - January 23-25	24	25	26 **HGS FIELD TRIP** **Johnson Space Center and Lunar & Planetary Institute**
27	28	29	30 **HGS LUNCHEON** **Mike Prescott** **Houston Club**	31		

GEO-EVENTS

MEETINGS

IN HOUSTON

AWG Dinner Meeting, Cathy Lee Farmer, "Jordan's Role in World Events, Past and Present", Village Cafe, 5935 Kirby in Rice Village, 6:00-8:00 p.m., Jan. 8.

HGS Environmental/Engineering Committee Dinner, Dr. Victor T. Jones, III, "Applications of Soil Gas Geochemical Methods in The Detection of Underground Contamination", Charlie's Hamburger Joint, 2222 Ella Blvd., 6:30 p.m., Jan. 9.

SPWLA Westside Luncheon, Holiday Inn-Houston West (I-10 at Hwy 6), 11:30 a.m., Jan. 10.

GSH Noon Luncheon, Ramada Northwest, 11:30 a.m., Jan. 14.

Permian Basin/Mid-Continent Dinner Meeting, J. Reed Lyday, "Berlin Field: Genesis of a Recycled Detrial Dolomite Reservoir, Deep Anadarko Basin, Oklahoma", Westin Oaks, 6:00 p.m., Jan. 15.

SPWLA Galleria Luncheon, Holiday Inn Crowne Plaza, 2222 West Loop South, 11:30 a.m., Jan. 15.

HGS International Dinner Meeting, Carlos A. Dengo, "Structure of the Eastern Cordillera of Colombia: A Tectonic Model for The Colombian Andes", Westin Oaks, 5:30 p.m., Jan. 16.

SIPES Luncheon, Tom Bulling & Rebecca Olsen, "3-D Seismic Gives Old Fields New Life", Petroleum Club, 11:30 a.m., Jan. 17.

SPWLA Greenspoint Luncheon, Baroid Cafeteria, 3000 North Belt, 12 Noon, Jan. 17.

HAPL/HGS Joint Dinner Meeting, Max G. Pitcher, "Exploration and Development Opportunities in the Soviet Union", Westin Galleria, 5:30 p.m., Jan. 22.

SPWLA Downtown Luncheon, Petroleum Club, 11:30 a.m., Jan. 22.

SPE Gas Technology Symposium, Jan. 23-25.

HGS Luncheon, Michael P. Prescott, "The Maurice Field: New Gas Reserves From Buried Structure, Oligocene Trend of Southwest Louisiana", Houston Club, 11:30 a.m., Jan. 30.

SCHOOLS AND FIELD TRIPS

HGS Environmental/Engineering School, HAL PC-AISIG, Groundwater Modeling With Expert Systems, HAL PC Office, 1200 Post Oak, 7:00-9:00 p.m., Jan. 17.

HGS Field Trip, Johnson Space Center and Lunar & Planetary Institute, Rice University Stadium Parking Lot, 8:45 a.m. - 2:00 p.m., Jan. 26.

COMMITTEE NEWS

THIS YEAR, A DRAWING WILL DETERMINE THE WINNER OF TWO OF THE GREAT TRAVEL PRIZES

Two To Tour Europe With KLM Royal Dutch Airlines
Business Class To Germany With Lufthansa Airlines
Two To Tokyo With Continental Airlines
American Airlines Flies Two to Rio De Janeiro

As you might have heard, we have changed the contest now so that everyone has a chance to win even the BIG prizes in this year's membership drive. The more members you endorse, the closer you get to receiving HGS Lapel pins, dinners, and trips to some great locations in the world. The two members who endorse the most new members will choose their foreign vacations, then two other's names will be drawn for the remaining two great foreign vacations. The top dinner prize will go to the member endorsing the third most new members and the drawing of names will determine the winners of the remaining prizes.

We have mailed HGS applications to 2600 Houston area AAPG members who have not yet joined. I bet you work with at least one of them, and I hope you will help us by providing some encouragement to them to join. Knowing what the HGS does can make you a better salesman when approaching prospective new members. The HGS has 32+ committees which offer services, cater to our special interests and allows the HGS to function efficiently. The dues are CHEAP and the monthly magazine, the *BULLETIN,* is a great way of keeping tabs on the what, when, who, where and how in Houston's geological industry.

Remember too, others you work with can also join: geophysicists (I'm one of them!); petrophysicists; geochemists; our engineering and production counterparts; exploration and lab technologists; geoscientists, teachers and students at the colleges and universities; and earth scientists in the environmental and space industry.

ONE OF THESE TRIPS COULD BE YOURS IN JUNE 1991!!

KLM Royal Dutch Airline's European vacation is called Europe by Design. The $3000 prize includes a round trip for two from Houston to Amsterdam, then onwards to your next stop(s) for at least 3 days in each, selected from a list of over 10 cities in 10 countries. Stay at the best hotels, travel by your choice of air, road or rail, and prearrange your daily activities out of dozens of exciting choices, called "unexpected pleasures". See Bavarian castles, hike the Swiss Alps, live it up on the Mediterranean. Once again, a great airline offers you a great prize.

Fly to Tokyo courtesy of Continental Airlines. Their in-flight service brings you to Japan before you leave the ground. On the way there, the two of you can visit Hawaii. Once you're in Japan, their famous culture and history will make this vacation unforgettable.

Another great prize available to you is a trip for two to Rio de Janeiro, Brazil, courtesy of American Airlines. Rio is a very picturesque city, with exciting beaches, night life and interesting people. American Airlines flies throughout South America, and is proud to offer you this special city.

Lufthansa Airlines will start your German vacation with two Business Class tickets from Houston to your German city of choice. From Germany, the rest of Europe is at your fingertips. Lufthansa's expertise with Eastern Europe, a region unavailable to most of us only a year ago, will help make your vacation greatly rewarding and easy.

Additionally, all active members CREDITED WITH 3 NEW MEMBERS WILL RECEIVE AN HGS LAPEL PIN. This is a popular award already received by over 60 members.

How do you enter the contest? It's easy. After locating a prospective member, just:

1. Print and sign your name as the first sponsor (upper of the two sponsor lines) on the application form.
2. Get a second HGS member to endorse the form (second line).
3. Check with the new member in a week to be sure that they mailed the form.

Remember: You must be an Active status HGS member to enter.

HOW DO YOU WIN? I'll keep track of the new members you endorse. The more members join, the more "credits" you'll have. After the top three contributors are determined, a drawing for all remaining prizes will be made from all remaining entries. Each member can win only one prize.

Membership Committee:
(My committee and I are ineligible for any prizes).

Mike Deming ..... Amoco
S. Kumar Bhattacharjee ..... SITA
Jeff Walters ..... Samedan
Ben Winkleman ..... ARCO
Jim Webb ..... BP Exploration
Marilyn Taggi Cisar ..... Shell
Robert Fryklund ..... Amerada Hess Corp.

If you need applications, just call 785-6402.
Good luck in this year's contest.

BRUCE A. FALKENSTEIN
Membership Chairman

ON THE MOVE

Sue Duffield is a technical writer with Landmark Graphics Corporation. Previously, a paleontologist with Amoco in New Orleans.

Joe McGee has joined PetroVal, Inc. as a geologist/geophysicist. Mr. McGee was formerly associated with Cities Service, LL+E, and Mark Producing. PetroVal, Inc., is a petroleum valuation company offering services in geology, geophysics, petrophysics, and reservoir engineering.

Joseph L. (Joe) Alcamo, to Senior Exploration Advisor, Ashland Exploration, Inc. in Houston, Texas. Previously Consulting Geophysicist in Houston, Texas for Ashland Exploration, Inc.

Stephen E. Zeboski, to exploration geologist, AEC Exploration Company, Houston. Previously with Monticello Energy, Dallas.

Marcus L. Countiss has joined Texoil Company on a full-time contract basis to generate prospects in South Louisiana. He was formerly on contract to BP Exploration as consulting geophysicist in their Offshore Texas Shelf group.

Rodney J. H. Smith retired on Halloween from Mobil, where he had held the position of Geophysical Consultant. Previously he had retired from Monsanto Company, where he had been Chief Geophysicist for many years. Prior to that he had been with Exxon and Royal Dutch Shell in various parts of the world. He will continue consulting for Mobil on a part-time basis.

HGS/GSH BASS TOURNAMENT

The third annual HGS Bass Tournament is being sponsored with GSH and will be held March 23 and 24, 1991. It will be located at Frontier Park Marina on Toledo Bend Reservoir. The tournament is open to all HGS/GSH members and their guests. This is usually a peak fishing season, so make your reservation for accommodations early. Trailers or campsites should be reserved by contacting Shirley at (409) 625-4712. Each member will be responsible for his/her own expenses. Teams consist of two people per boat, however, a third person may be paired with a third from another boat. Bring your own boat, or boats may be rented. To register, complete the form and send it with a $40.00 check to the HGS office, and contact either Bill Vest (713) 652-5064/350-4274, or Joe Alcamo (713) 531-2979/353-8341 for complete details and regulations.

We would like to take this opportunity to congratulate last year's winners: First place went to Joe Alcamo and Bill Roach with 20.6 lbs., second to Dan and Jerry Hayes with 11.21 lbs., and third place to Bob Dean and Brian Arabie with 10.7 lbs. Danny Fontana won the Big Bass jackpot wagered with the Houston Association of Petroleum Landmen Tournament with a 3.8 pounder. Second place went to Joe Alcamo with a 3.3 pounder, and Robbie Gilbert came in a very close third with 3.2 lbs.

Special thanks to our sponsors for making this tournament a success: Ashland Exploration Inc., First Seismic Corporation, Haliburton Logging Services, Schlumberger, and Strago Petroleum Corporation.

Winners from left to right: Robbie Gilbert, Dan Hayes, Bob Dean & son, Jerry Hayes, Brian Arabie, Joe Alcamo, and Bill Roach. Danny Fontana not pictured. (He was off collecting Jackpot Prize money.)

REGISTRATION FORM: HGS BASS TOURNAMENT

Name: _____

Partner's Name: _____

Address: _____

Phone: (home) _____ (work) _____

Enclose check payable to:
HOUSTON GEOLOGICAL SOCIETY

Return with this form to:
Houston Geological Society
7171 Harwin, Suite 314
Houston, Texas 77036
(Phone 785-6402)

HOUSTON GEOLOGICAL AUXILIARY

HAPPY 1991: With the busy Holiday Season behind us, we will have a brief breather before the gala evening on February 1 at Lakeside Country Club (see announcement on page 40). Sue Bullock and Hjordis Hawkins and their committee have been busily preparing for "Mardi Gras Mania."

HGS Members: Please note the invitation in this publication gives all the details.

We don't want anyone to miss the next two exciting functions: the Mardi Gras gala on February 1 and the May 16 luncheon at the Westin Galleria Hotel. The speaker is P. W. J. Wood. We invite all HGS members to make reservations early. Lois Matuszak and Nancy Poynor are Chairpersons.

To those of you who would like your spouse to enjoy membership in the Auxiliary, please complete the application below and return with a check for $10. Mail to:

Mrs. Richard Steinmetz
HGA Vice President, Membership
11734 Riverview
Houston, Texas 77077

HGA MEMBERSHIP FORM

(Last Name) (Your Name) (Spouse's Name)

Address _____

_____ Zip_____

Home Telephone _____

HGS Member's Company _____

HGS FIELD TRIPS*

NASA, JOHNSON SPACE CENTER AND LUNAR & PLANETARY INSTITUTE

DATE & LOCATION: Saturday, January 26, 1991, 8:45 a.m. - 2:00 p.m. **please note time change;** Meet in the Rice University Stadium parking lot, entrance 7 on University Blvd. at 8:45 a.m. Bus transportation will be provided to Johnson Space Center.

SCOPE OF TRIP: NASA representatives will present the latest information about the Moon's history and how interpretation was aided by moon rocks. Photographs of the Moon and Earth will be displayed, accompanied by discussions on their application to science and exploration. We'll view moon rocks in the lab and watch a core undergoing examination. Discussions will include techniques of rock collecting and handling, and astronaut training in sample selection and geological observation under hostile conditions. The trip will conclude with a tour of Mission Control.

TRIP LEADERS: Dr. John Dietrich and Dr. David Amsbury, NASA

COST: $10 for bus fare. Participants will buy their own lunch at the JSC Cafeteria.

REQUIREMENTS: Participants must be a U.S. Citizen or hold a valid green card. Registration will be limited to the first 45 persons.

INTRODUCTION TO GEOSCIENCE WORKSTATIONS

DATE & LOCATION: Saturday, February 9, 10:00 a.m. to 2:00 p.m., Sierra Geophysics, Inc., 2700 Post Oak Blvd., Suite 1900, in the Geosource Building at the Galleria.

SCOPE OF TRIP: This trip is designed to familiarize the participant with geoscience workstations and their increasing role in petroleum exploration and development. It offers an opportunity to work hands-on on the station to develop integrated geologic and geophysical interpretations.

COST: $5.00. Lunch and soft drinks will be provided.
Contact Chuck Barton at 961-1077 for information.

THE ARBUCKLE MOUNTAINS

DATE & LOCATION: Thursday, April 25th - Saturday, April 27th, 1991. Arbuckle Mountains near Ardmore, Oklahoma

SCOPE OF TRIP: On this trip, we will see the classic outcrops, quarries, and roadcuts which expose the lower Paleozoic section in the Arbuckle Mountains. We can see the early Cambrian rhyolites which flooded the downdropped aulacogen. The 8,000 ft. of Arbuckle is stratigraphically interesting and complicated by brecciation and dolomitization. We'll discuss movements along the Washita Valley faults and the associated oil fields. A visit to the Ordovician glass sand quarries and the asphalt mine is planned. At Turner Falls, we can see not only the travertine accumulation but also the conglomerates by which we can time the Arbuckle uplift.

TRIP LEADER: Dr. Nowell Donovan, Texas Christian University, Fort Worth, Texas

COST: Less than $200, two nights lodging, meals included, bus from Dallas. Participants must convene at Dallas airport for ride to Ardmore.

If interested, call John Turmelle, (713) 871-3655.

*HGS Field Trip registration form is on page 29.

HGS SHORT COURSES

Sponsored by the HGS Continuing Education Committee

APPLICATION OF CLIMATE MODELS TO PALEOENVIRONMENTAL PREDICTION

By Eric J. Barron,
Director, Earth System Science Center, Penn State University

DATE & TIME: Thursday and Friday, February 21-22, 1991, 7:30 a.m. - 4:15 p.m.

LOCATION: Amoco Production Company, WestLake Park Blvd. (N. off Memorial, between Eldredge and Hwy. 6) Room 508(A&B) WestLake II (Texas Commerce Bank Building)

PARKING: Amoco garage (visitor), or WestLake II-III garage to the west.

COST: $120.00 (HGS member), $130.00 (non-member)
(NOTE: THIS IS A 2-DAY SHORT COURSE)

CLASS: Class size is limited to 40 (minimum registration required is 25).

COURSE OUTLINE:

1. **Introduction**
   - The climate system
   - Climate models (atmosphere and ocean)
   - Application and use of climate models in the earth sciences
2. **Factors Governing Climate Change on Geologic Time Scales**
   - Paleogeography and climate
   - Atmospheric composition changes
   - Sea level and climate change
   - Milankovitch cyclicity
3. **Application of Climate Models in Earth History**
   - Upwelling and petroleum source rock prediction
   - Lacustrine petroleum source rock prediction
   - Precipitation and run-off pattern prediction
   - Severe storms and sedimentation patterns
   - Ocean current changes and continental margin sedimentation patterns
4. **Multivariable Climate Reconstruction**
   - Multivariable prediction & synthesis: Cretaceous paleoenvironments
   - Model / data comparison
5. **Reconstruction of Regional Paleoenvironmental Histories**
   - Basis for stratigraphic reconstruction
   - Case studies for continental margins
6. **Frontiers**
   - Basin-scale circulation
   - Meso-scale circulation
   - Global paleo-environmental model database: Phanerozoic

Please register before February 10, 1991.

"MASTERY OF LEARNING" WORKSHOP

By Chris Welsh*

"The most important skill to acquire today is the ability to learn"

DATE & TIME: Friday, February 15, 1991, 7 p.m.-11 p.m.; Saturday, February 16, 1991, 9 a.m. - 8 p.m.; Sunday, February 17, 1991, 9 a.m. - 8 p.m.

LOCATION: Location to be announced

COST: $195.00 (HGS members only)
(Note: this is a 3-day short course currently offered to the public at $350)

CLASS: Class size is strictly limited to 30 (minimum registration required is 15).

COURSE SUMMARY: The "Mastery of Learning" Course teaches 6 skills designed to help people become more successful and creative. Topics and skills include the practice of mastery, paradigms, thinking on paper, mental rehearsal, mind mapping and looping, learning and thinking barriers, comprehensive reading, memorization techniques and restructuring. Participants will receive hands-on training in both left and right brain techniques. Geologists who have taken the course have reported and increase in their ability to visualize 3-dimensionally, absorb new information, take risks, present ideas, plan field mapping projects and keep up with technical reading.

This course has been arranged by special request through the HGS Continuing Education Committee, on a one-time only basis at this price. For more information, contact Synthia Smith at 680-6352, or Chris Welsh (instructor) at 439-1442.

**See article in this issue for biography.*

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THE KEY TO SURVIVING AND PROSPERING IN THE 90'S

By Chris Welsh*

The Second Industrial Revolution

We are in the first 50 years of the second industrial revolution. The first industrial revolution started about 250 years ago when the patent was granted for the flying shuttle used in weaving cloth. It centered on developing machines that would extend, leverage, and multiply man's physical strength and capabilities. It made intensive use of material resources. Countries that had access to the material resources had an edge economically.

The technology of the second revolution is centered on extending, leveraging, and multiplying man's mental capabilities. The new jobs created by this revolution require a higher level of education. In the first revolution, most jobs did not require a high school education. Now they do.

One major concern of the labor force during the industrial revolutions (both the first and the second) was that technology was going to put workers out of work. In both revolutions, the work force feared that technology was going to permanently displace them. In the 200+ years of the first revolution and so far in the opening decades of the second revolution, it appears that the new technologies creat approximately 10-12 new jobs for every 10 jobs that they eliminate.[1] The newly created jobs offer higher pay, but require higher skill level and a better-educated worker.

Although there will be ups and downs in the economy and productivity over the next two decades, we will most likely see an increase in employment and productivity. With these increases there will be an increase in the average educational level of the worker on the job. As the rate of change accelerates, we need to provide retraining and new avenues for the displaced workers to get back into the mainstream and not into new dead end jobs.

The Problem

We live in a time when the job market is changing rapidly. Older industries and technologies are becoming obsolete. They are either being phased out or they are failing in the competition with newer technologies. New technologies and the jobs that they create are emerging at an accelerating rate. Low-tech, low-skill industries are moving out of the United States to third world countries where the cost of labor is lower.

High-tech industries are finding it often difficult to find adequately trained personnel in the United States. "60 and effort by government and industry, as did the British Japanese corporation, uses high school graduates to statistically maintain quality control for its semiconductor lines in its factory in Japan. When the company opened a branch in North Carolina, they had to hire people with a graduate school education to do the same job. They could not find high school or college graduates who could be taught the technology.

With the acceleration of new technology we are looking at having to recycle our knowledge every 8-10 years.[2] A person entering any job field today can look forward to having to be retrained several times before he or she retires.

The Key

In order for our economy to grow and prosper, we need a work force that is educated, adaptable, and can learn. They need to learn to transfer skills from one job or career to another. To do this people need to recognize that training and retraining are a fact of life. They do not see learning as a life-long process. Instead, they had hoped for something different; that they could know it all and not have to learn more.

"With the acceleration of new technology we are looking at having to recycle our knowledge every 8-10 years. A person entering any job field today can look forward to having to be retrained several times before he or she retires."

The key to having training be most effective for both the trainer and the trainee is learning to learn. Most people were not taught how to learn effectively in school. We live in a culture in which the rate at which new information appears is accelerating and that acceleration is accelerating. The techniques taught to us in school are insufficient to manage the volume of information we need to learn.

The whole background in which learning takes place needs to be altered. Learning, in today's culture and workplace, is a lifelong process. People need to see learning as a possibility for their future rather than a burden. We need to be taught techniques that can enable us to learn the volume of information that we need to grow and prosper in today's culture. We also need to make sure that the institutions that deliver the training and education nurture and support the individuals so that they fulfill their potential.

Editor's Note: The author of this article, Chris Welsh, will be offering an HGS Short Course entitled "Mastery of Learning" in February. This general article was written by Welsh as an overview of American industry in the 90's.

References

1. Kurzweil, Raymond. *The Age of Intelligent Machines*. Cambridge, Massachusetts: The MIT Press, 1990
2. Wurman, Richard Saul. *Information Anxiety*. New York; Doubleday, 1989

CHRIS WELSH—Biographical Sketch

Chris Welsh is the founder and president of Mastery of Learning, a training and educational consulting firm. He has provided individuals, the public, and corporations with consulting, training, and educational services for over a decade.

Mr. Welsh graduated from Texas A&M in 1969 with a B.S. in Zoology and later received a B.S. in Medical Technology from the University of Hawaii in 1974. Prior to developing the Mastery of Learning course, he trained dolphins and whales for the U.S. Navy in Hawaii. In addition to private and public work, Mr. Welsh is currently a part-time instructor at the University of Houston in the Job Resource Center where he trains displaced workers in learning to learn skills.

The HGS Continuing Education Committee has arranged for Mr. Welsh to offer the Mastery of Learning 1 course for HGS members in February. (See announcement on p. 39)

FEATURE ARTICLE

PETROLEUM GEOCHEMISTRY IN OIL PRODUCTION

By Wallace G. Dow & Suhas C. Talukdar, DGSI

ABSTRACT

Modern geochemical techniques that are commonly used in exploration recently have been applied to help solve oil and condensate production problems in oil and condensate reservoirs. The geochemical approach provides an independent method to define and assess petroleum reservoirs and is an extremely useful accompaniment to the more traditional reservoir geology and production engineering tools. We review here the most important geochemical methods and their applications in the field of oil production.

Geochemical well logging including organic carbon, Rock-Eval Pyrolysis and solvent extract data, together with gas-chromatography (GC) and pyrolysis-gas-chromatography (PY-GC), can define potential reservoir sequences or producing horizons in common discovery situations where an oil leg definition is ambiguous. The method can also delineate the hydrocarbon bearing reservoir intervals and the producibility (API gravity) of the reservoired oil in highly fractured or heterogeneous reservoirs where data from routine wireline logs are often inconclusive.

High resolution gas-chromatographic fingerprints of whole oils have been applied in recent years to identify lateral and vertical continuity of reservoirs in oil fields. The method can be extremely useful in structurally complex areas and in heterogeneous carbonate reservoirs where precise structural mapping and identification of permeability barriers are difficult despite abundant well-bore control and 3-D seismic data. This method has also been used in enhanced recovery operations and to solve several other production related problems such as leakage in multipay zones and detecting drilling fluid contamination. The paper also discusses the use of light hydrocarbon data from gas-chromatography to locate new producing horizons in established producing areas.

INTRODUCTION

Production problems are numerous and diverse in origin and influence field development plans in one form or the other. Geologists and petroleum engineers have realized that optimal field development and reservoir management can only be achieved by combining all available information about the reservoir. They usually use the results of wireline logs, petrophysical and petrographic analyses of cores and 3-D seismic surveys to create better constrained reservoir models. One technique that is often overlooked is the use of geochemical analyses of cores and reservoir fluids to better

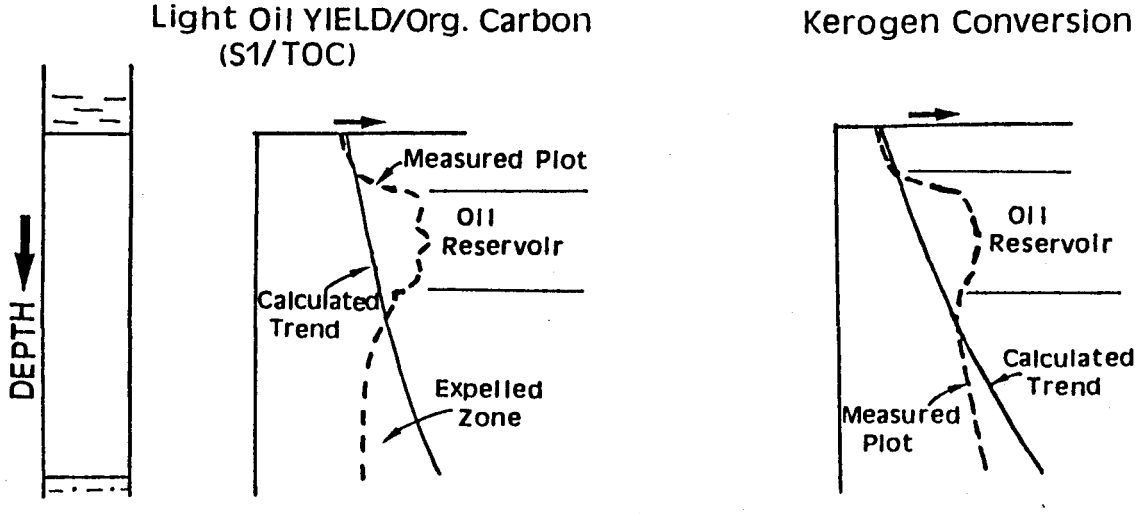


Fig. 1. Identification of producing horizons in fractured source formations.

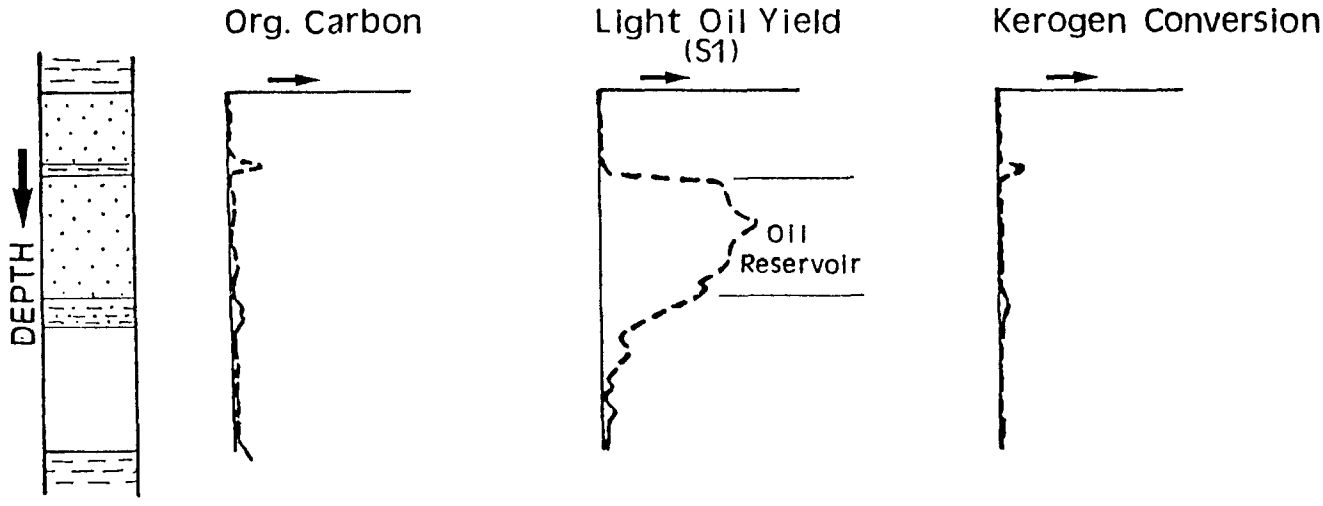


Fig. 2. Identification of producing beds within the reservoir sand thickness.

understand the reservoirs and their geometry.

Petroleum geochemistry has been used in the past primarily as an exploration tool. New developments, however, have expanded its applications to production and development problems as well. Geochemistry provides an independent conclusion and is an ideal supplement to standard evaluation tools. In some instances, it can solve the ambiguity or conflicting interpretations resulting from other methods. The geochemical method is attractive because it is less time consuming and far less costly than conventional reservoir evaluation methods.

Reservoir geochemistry uses standard analyses such as high resolution gas-chromatography (GC) and pyrolysis-gas chromatography (Py-GC), biomarkers (GC-MS) and sometimes organic carbon and Rock-Eval pyrolysis. The different techniques study the hydrocarbons and bitumens contained in reservoir rocks or potential reservoirs as well as producer oils and condensates.

In this paper, we outline some important applications of geochemistry in production and development of oil fields using geochemical logging and oil fingerprinting.

DELINEATION OF RESERVOIR INTERVALS AND PREDICTION OF PRODUCIBILITY (API GRAVITY) OF RESERVOIRED CRUDE OILS

When routine methods are inconclusive, geochemical logging of rock samples can be used to help identify and estimate the producibility of the reservoir intervals throughout the penetrated section.

The technique to identify the productive horizon can be applied in highly fractured heterogeneous reservoir beds (shales or limestones) which also may be source rocks. The method can help identify oil bearing zones in sandstones or other non-source limestone reservoirs. The free hydrocarbon bearing intervals are identified from TOC and Rock-Eval data on cuttings and core samples. (Figs. 1 and 2).

Estimation of API gravity from rock samples prior to drill-stem testing is important because it can be an indication of reservoir producibility. A relatively rapid method, for example, was developed by Shell to determine the API° gravity of a small amount of oil contained in or adsorbed on sidewall samples or cores. It uses FID measurements to estimate the ratio of the amount of hydrocarbon vapor produced within a prescribed high temperature range to the total amount vaporized. Estimations of API gravity can also be made by analyzing cuttings or core samples with pyrolysis-gas chromatography (PY-GC). Monitoring API gravity from rock samples throughout the reservoir section can help indicate the proximity of tar mats and gas oil contacts. These data are extremely important in making well completion decisions.

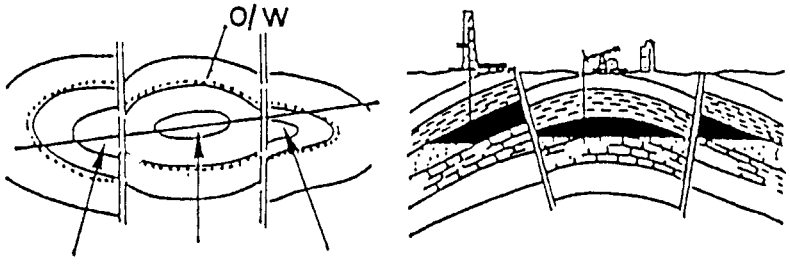
A case study for identifying hydrocarbon-bearing reservoir intervals in the fractured Monterey Formation of California is given by Robinson (1990). He located the intervals with reservoired hydrocarbons by using S_1/TOC and kerogen transformation ratios. He also observed depressed values of T_{max} in zones of high concentrations of asphaltenes.

RESERVOIR CONTINUITY PROBLEMS

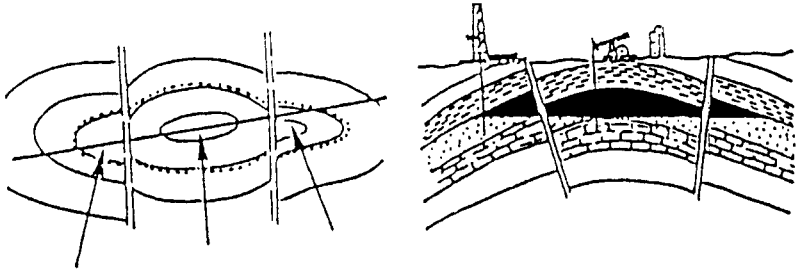
A development geologist or engineer can now use detailed gas-chromatography (GC) fingerprinting of oils to determine reservoir continuity within a field or between adjacent fields.

The lateral and vertical continuity of reservoirs can be disrupted because of permeability barriers resulting from facies changes, compositional and textural heterogeneity, variations in fracture intensity and structural dislocations. It is important to know about the reservoir continuity during the early stages of field development but is often very difficult to predict because of insufficient reservoir and structural data from widely spaced wells. It can be very time consuming and costly to decide on the appropriate model (e.g. Figs. 3 and 4) using conventional geological and engineering techniques alone. A rapid and inexpensive solution may be obtained by detailed fingerprinting of oils

Fig. 3

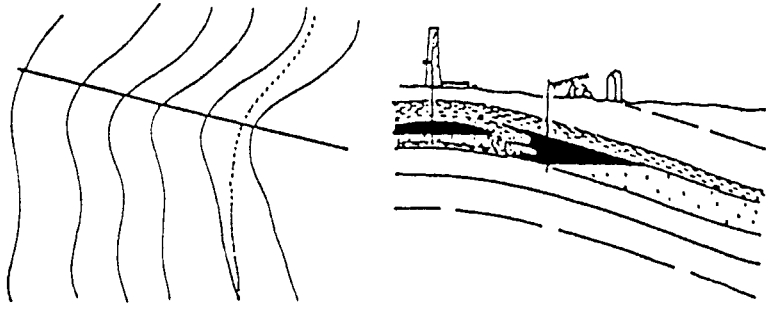


Separate pools
Different oil fingerprints

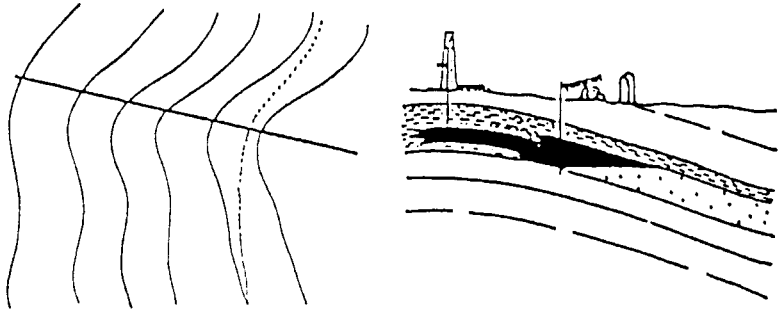


A single pool
Similar oil fingerprints

Fig. 4.



Separate pools
Different oil fingerprints



A single pool
Similar oil fingerprints

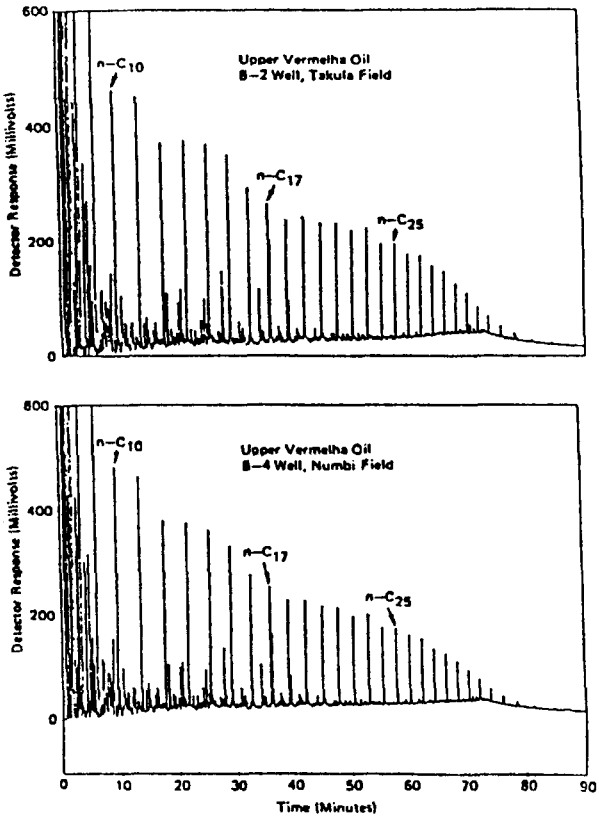


Fig. 5. Similar n-alkane and isoprenoid distributions in the two whole oil gas-chromatograms show similarity of source and maturity.

from producing wells using high resolution gas chromatography. The data can be integrated with wire line logs, reservoir models, pressure tests and structural information to develop a better understanding of the oil field in order to make improved development and reservoir management plans. There are several case studies in recent years for identifying reservoir continuity using GC fingerprints (Kaufman, *et. al.*, 1990; Lindberg *et. al.*, 1990; Gay, 1990). The method has been applied successfully in sandstone and limestone reservoirs as well as in complex structural areas.

In approaching production problems, it is necessary to compare detailed gas-chromatographic "fingerprints" with special procedures because oils from separate oil pools within a field or adjacent fields may often look very similar in the n-alkane and isoprenoid distributions alone (Fig. 5). Differences can be observed, however, among the lesser naphthenic and aromatic components, especially within the nC_9-nC_{18} molecular weight range (Fig. 6). Oils from separate pools are often modified differently since their initial accumulation. These differences can result from the distinct alteration effects, PVT relationships and fluid-rock interactions. A star plot utilizing several peak ratios (usually twelve or sixteen) is used to illustrate these differences graphically (Fig. 7). Cluster analysis is another useful way to display and analyze the results when the number of oils is large (Fig. 10).

ENHANCED RECOVERY OPERATIONS

One of the greatest causes of trouble in enhanced recovery operations is heterogeneity in the reservoir. The geometry of sub-reservoirs and their flow characteristics such as porosity, permeability and directional permeability

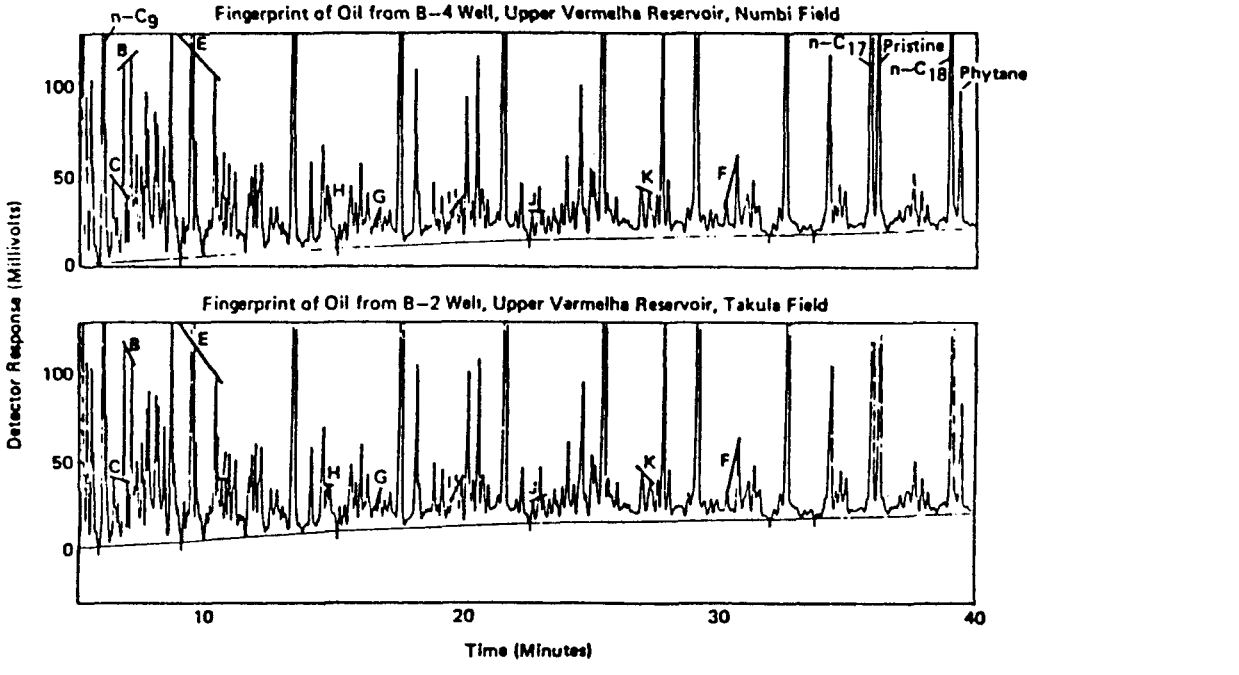


Fig. 6. Portion of whole oil chromatograms (nC9 through nC18).

must be determined as accurately as possible. Geologists attempt to do this with detailed geologic studies of cores and well logs and reconstruction of depositional environments. It is also customary to inject tracers so that preferred directions of flow can be identified.

Detailed oil GC fingerprinting can now be used to help resolve reservoir continuity problems. The method is very rapid and inexpensive. Detailed comparison of GC finger-

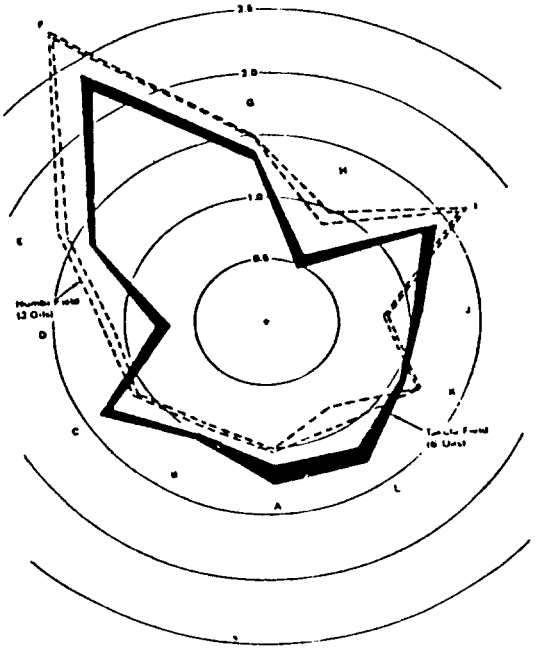


Fig. 7. Star plot showing similarity of oils within each field and difference between fields.

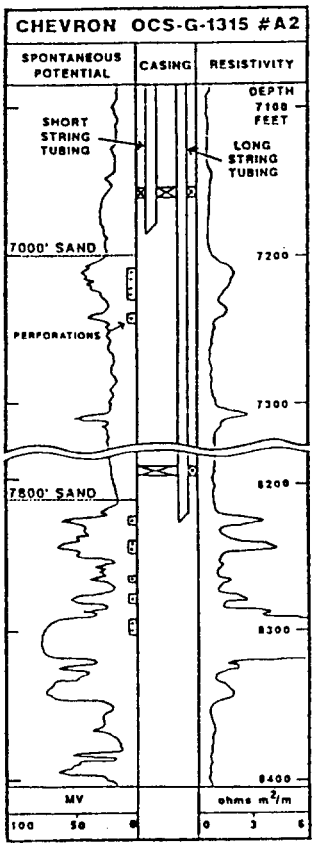


Fig. 8. Induction log covering the 7000° and 7300° sands in the Main Pass 299, OCS-G 13-15 No. A-Z well. The location of the perforations and schematic of the tubing string configuration are also shown.

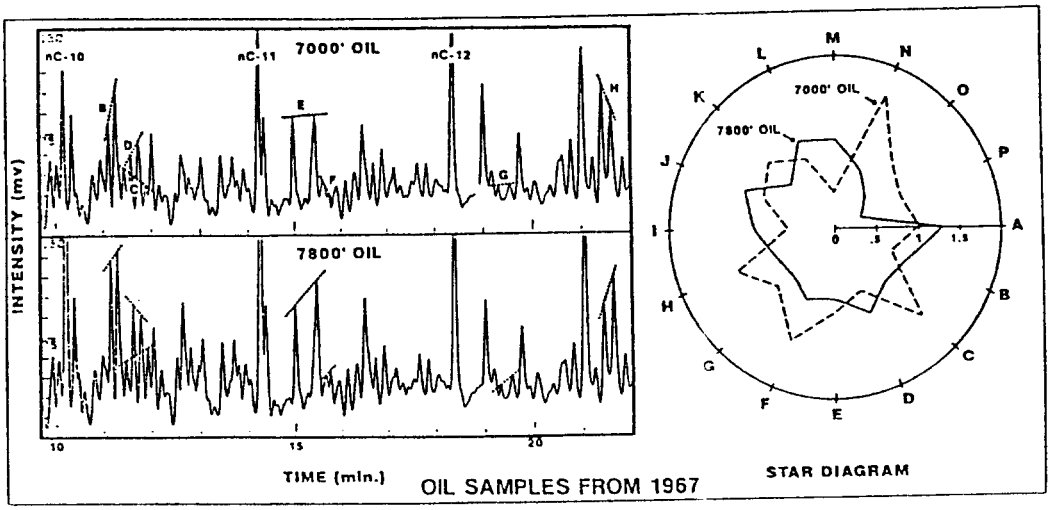


Fig. 9. n-C10 to n-C13 range of the capillary chromatogram and star diagram for the 7000° and 7800° oils collected about 1967 from the No. A-2 well.

prints can indicate continuity or discontinuity of flow paths between wells. If oils are produced from two or more sands in a multiple reservoir system, the method can locate the sand facies that forms a continuous reservoir and where permeability barriers occur. The results can be useful in designing a more efficient and economical secondary recovery program. The method is similar to that shown in the previous example. A case study of using GC fingerprinting technique for reservoir continuity in a waterflood project is given by Gay, 1990. The study based on geochemistry and petrographic engineering and electric-log data, could reveal the best parts within one of the three sand facies in a sand body on which to focus the revised waterflood project.

PROBLEMS OF LEAKAGE AND COMMINGLED PRODUCTION

In dual producing wells, casing and tubing can, over time, develop leaks due to corrosion which can lead to unplanned commingled production. This can alter reserve estimates, royalty payments, and affect site selection of future development or injection wells. Early detection of leaks can be made with detailed GC fingerprints of oils collected over time.

A case study of the Gulf Coast published by Kaufman *et. al.* (1990) is one such example (Figs. 8 through 11).

In the Gulf Coast Main Pass 299 Field, a well was completed in 1967 as a dual producer in the 7,000′ sand (short tubing string) and the 7,800′ sand (long tubing string). In 1986, commingled production was suspected but the extent of leakage was not known.

Gas chromatography of oil samples produced from both tubing strings in 1967, 1972, 1981, 1983 and 1986 and comparison of their detailed fingerprints successfully detected the location, timing, and progression of the leak. An artificial laboratory oil mix program calculated the relative contribution from each reservoir over time since the leak began.

DETECTION OF DRILLING FLUID CONTAMINATION

Petroleum based products such as diesel oil added to the mud system can be a source of contamination and affect formation evaluation. Contradiction with log interpretation may arise in pay assignment if contamination of sidewall or conventional cores with diesel oil remains unidentified. A comparison of detailed gas-chromatographic fingerprints in the $nC_{15}+$ range obtained from extracted cores or cuttings, drilling mud and the diesel used during drilling can help identify the natural oil from the contaminant.

FINDING NEW PRODUCTIVE HORIZONS

Whole oil gas-chromatography data of a crude oil or condensate can help predict whether any accumulation related to the produced oil or condensate can be found in other potential reservoirs identified by seismic or well data. It also can define various types of reservoir oil alteration.

For example, loss of light hydrocarbons in oils could occur due to bacterial degradation and accompanying water washing, thermal maturation, and evaporative fractionation. Evaporative fractionation as described by Thompson (1987) is caused by the loss of light hydrocarbons in gas solution from oils as a result of contact with migrating gas.

Whole oil gas-chromatography can show if an oil has lost any part of its light hydrocarbon fraction. If the loss is due to evaporative fractionation, the remaining light hydro-

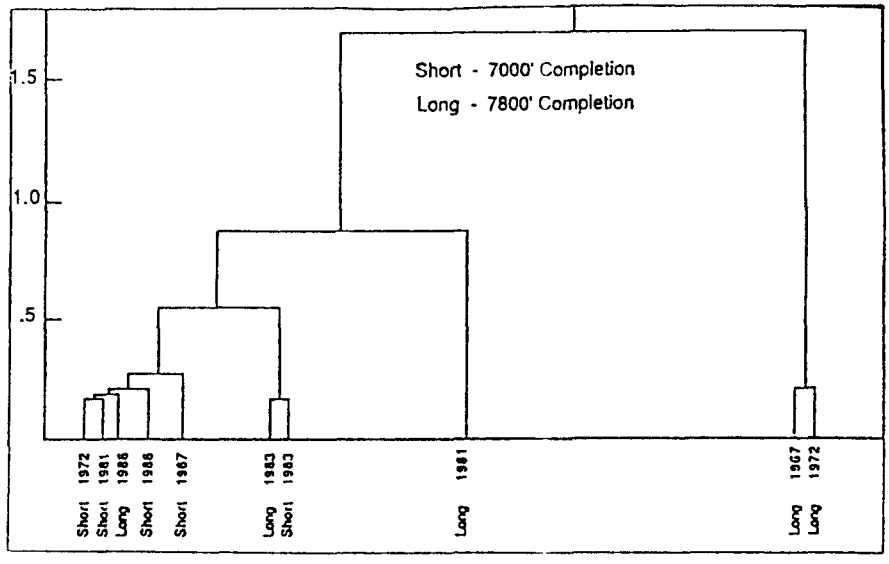


Fig. 10. Dendrogram of the cluster analysis of the ten oils collected from 1967 through 1986 from the short and long tubing strings of the No. A-2 well; sixteen ratios used.

carbon fraction will show abnormally high concentrations of aromatic and naphthenic hydrocarbons relative to n-alkanes. Evaporative fractionation is wide-spread in oils of many rapidly subsiding basins such as the U.S. Gulf Coast and offshore Trinidad. Fig. 12 shows the example in Trinidad. It is possible then, that the light hydrocarbons which migrated out of the oil would accumulate as condensates in reservoirs at higher structural levels (Fig. 13). If the produced hydrocarbon type is a condensate resulting from evaporative fraction, there is the possibility of locating oil deposits in deeper reservoirs (Fig. 14). The phenomenon is very common in the U.S. Gulf Coast region. Areas containing mature condensates, on the other hand, are less likely to contain less mature crude oils at greater depths.

In some producing basins, more than one petroleum system (source-migration path-reservoir-seal-trap) might exist, all of which may not have been defined. Source rock evaluation and oil-to-source correlation could be very important in identifying new petroleum systems and can lead to the discovery of new productive horizons in established producing areas.

Figure 15 gives a hypothetical example. In well A, oil I derived from the source rock SR I is produced from the reservoir RES I. An exploratory well drilled in an adjacent structure (well B) found no oil due to a pinch out of the RES I sands indicating that a prospect at location C would also be nonproductive. It did, however lead to the identification of another, but immature, oil source rock (SR II) and a younger reservoir (RES II) shallower than the oil I accumulation. This recognition could lead to the discovery of a new oil type (OIL II derived from mature SR II) in encouraging geochemical observations. A second possibility might be a stratigraphic trap in RES II that could be filled with oil from SR I. If the RES II pinchout could be identified, a second well might be drilled at Location D.

CONCLUSION

We have tried to illustrate some of the ways that petroleum geochemistry can help development geologists and engineers do their jobs better. There are many more. Geochemistry is not just an exploration tool but has many applications in producing basins as well. It is no longer valid to say: "We have production, so there must be source beds and we don't need geochemistry." Like any other technology, geochemistry has applications in every stage of petroleum exploration and production.

REFERENCES

Gay, A., 1990, Integrated geologic-engineering study of the Kurten Field Waterflood, Abstract, Bull. AAPG, Vol. 74, No. 5, p. 660.

Kaufman, R. L., A. S. Ahmed, R. J. Elsinger, 1990, Gas Chromatography as a development and production tool for fingerprinting oils from individual reservoirs: Applications in the Gulf of Mexico. SEPM Spl. Publication, 20p. (in print).

Lindberg, F. A., A. S. Ahmed, C. T. Bluhm, 1990, The role of Oil-to-Oil correlation in the development of the Safah Field, Oman, Abstract, Bull. AAPG, Vol. 74, No. 5, p. 705.

Robinson, V. D., 1990, Reservoir delineation and estimation of producibility of hydrocarbons by organic geochemical logging. Abstract, Bull. AAPG, Vol. 74, No. 5, p. 750.

Thompson, K. F. M., 1987, Fractionated aromatic petroleums and the generation of gas-condensates. Org. Geochemistry, Vol. 11, No. 6, p. 573-590.

TECHNICAL ARTICLES INVITED

The readers of the HGS *Bulletin* are invited to submit original geoscience articles, especially related to the Gulf Coast. Articles pertaining to exploration concepts, trends, field reviews or environmental issues are especially welcome.

Please call either Bill Roberts (465-2228) or Nelson Steenland (666-0266) if you are interested in submitting an article.

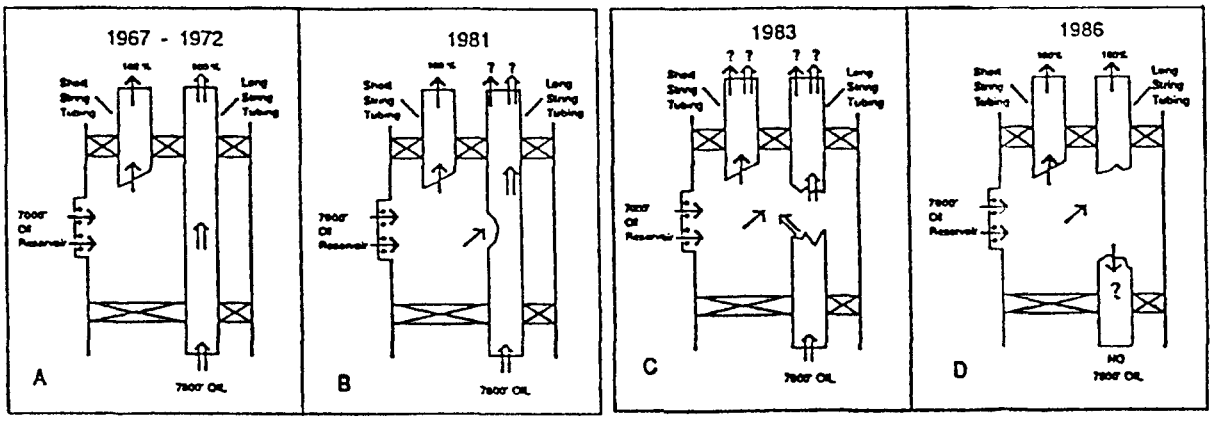


Fig. 11. Schematic of the flow paths of the oils from both completions at each of the sampling times. The solid arrows represent 7000° oil and the open arrows represent 7800° oil.

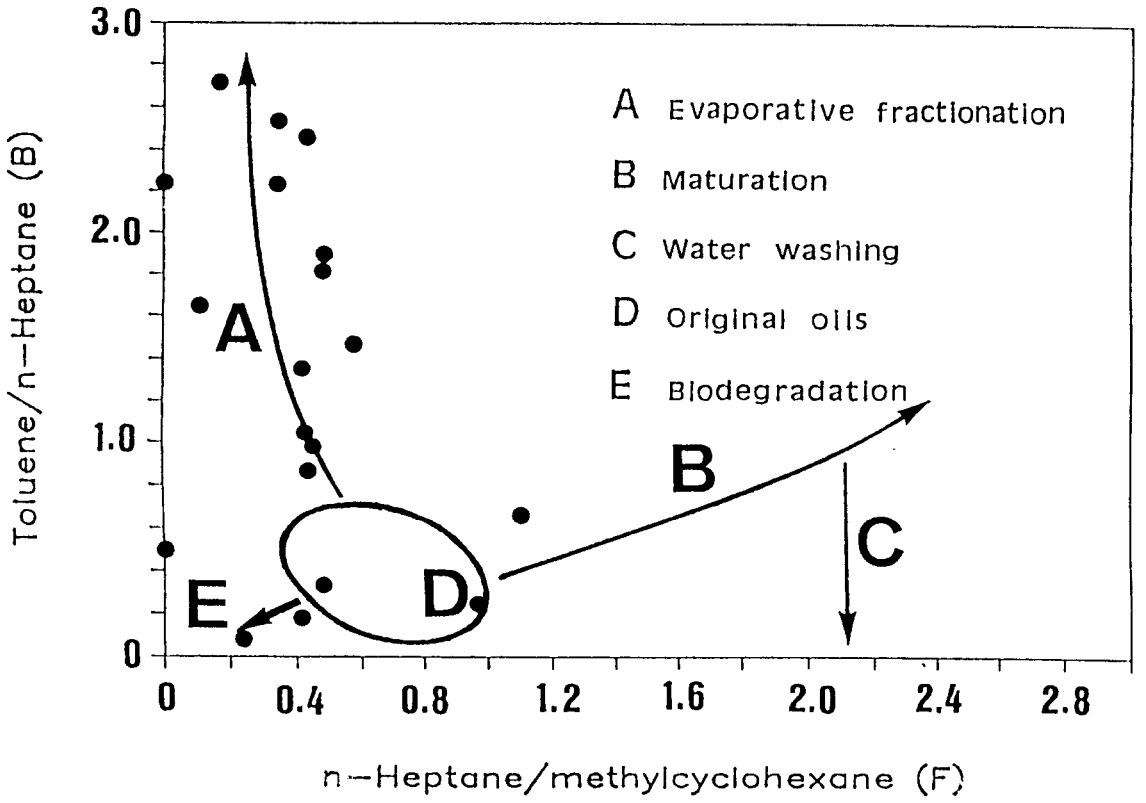


Fig. 12. Evaporative fractionation of oils in offshore Trinidad.

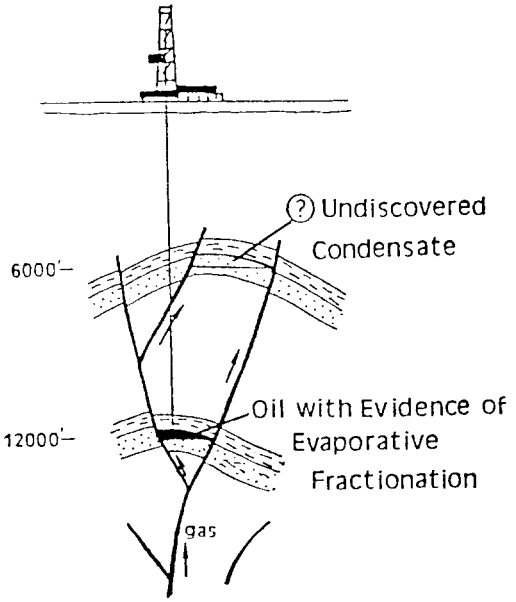


Fig. 13. Possible condensate find based on the discovery of oil showing evaporative fractionation.

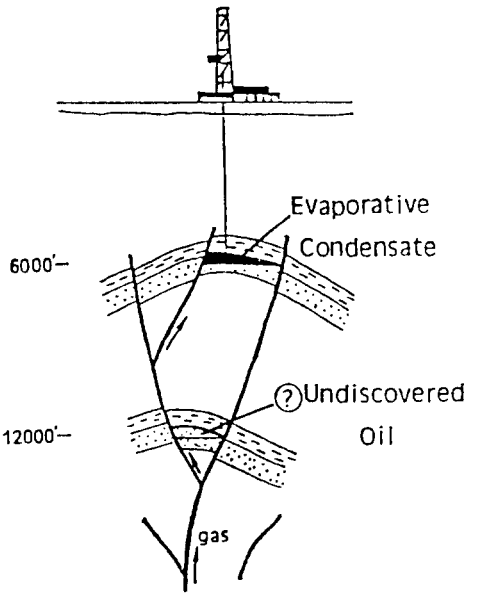


Fig. 14. Possible oil find based on the discovery of evaporative condensate.

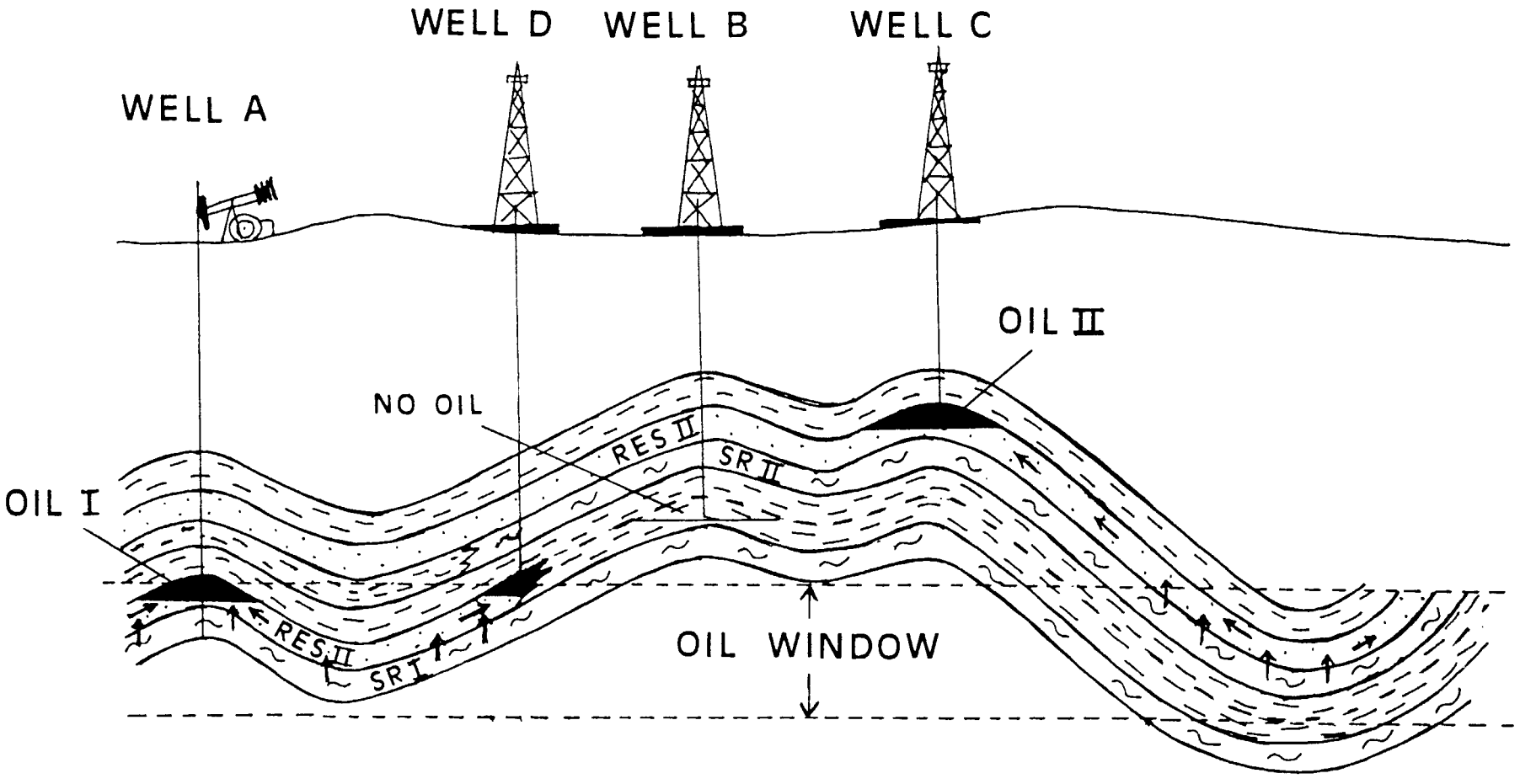


Fig. 15. A hypothetical example of geochemical application in existing mature basins.

Fig. 15. A hypothetical example of geochemical application in existing mature basins.

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EXPLORATION ACTIVITY REVIEW

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National Rig Count: November 19—1,103; Year Ago—1,040
Gulf of Mexico Rig Count: 150

GULF COAST

Texas

Eagle Oil & Gas will drill a 15,000′ **lower Wilcox** test in Hinnant Ranch Field in northeastern **Zapata** County. The #1 Fulbright is about 4600′ southeast of the Hughes & Hughes #1 Fulbright, discovery for Hinnant Ranch Field, which was completed from the Pettus (Yegua) at 1611-18′ after unsuccessfully testing the Wilcox from 8404′ to 9510′. Nearby producers are mainly shallow Jackson wells in Cuellar Field. At the Carrizo Wilcox horizon the deeper pool wildcat spots on northeast dip between a pair of down-to-the-east regional faults.

Farther east, in west-central **Brooks** County, location has been staked for a scheduled 2700′ **Frio** wildcat one mile northwest of Miocene and Frio production at Alta Mesa North Field. The Hawn Brothers #2 Mestena is about 2500′ southeast of the operator's recently abandoned #1 Mestena, also a 2700′ test. At the base Miocene horizon the new venture spots on the northwest flank of the Alta Mesa dome, updip to the #1 dry hole.

Waters Operating will horizontally drill the upper Cretaceous at its #1 Yanta, about 2 miles south of the old Adams Field (Navarro through Buda production) in southern Medina County. The wildcat, the first horizontal test for **Medina** County, will reach a measured depth of 3322′ (1750′ TVD), with a lateral displacement of 1900′. Likely targets include fractured reservoirs such as the **Anacacho, Austin Chalk** and **Buda.** Structure at the base Austin Chalk is southeast regional dip.

In eastern **Goliad** County, Mecom Energy has staked a 16,500′ **Wilcox** test in the southern portion of Swickheimer Field amidst shallow Frio gas producers. The #1 Swickheimer, et al-TAU is 2 ¾ miles southwest of Inexco's #2 Swickheimer which drilled the Wilcox from 12,200′ to TD at 13,522′, and was completed as a gas well from shallow Greta sands at 2759-62′. At the Vicksburg horizon the deeper pool wildcat appears to be located on a broad, southeast plunging nose upthrown to a large regional down-to-the-basin fault.

Farther north, in adjoining **Dewitt** County, North Central Oil will drill a 6200′ **Yegua** wildcat 1½ miles south of Yegua gas production at Doolittle Southwest Field. The #1 Wendel, et ux is about 3600′ southeast of the dry Lone Star #1 Means which logged several thin Yegua sands between 4820-5530′. At the top Wilcox horizon the new test spots on the faulted northwest flank of the large Helen Gohlke anticline.

Ultramar Oil & Gas has scheduled a 17,500′ deeper pool wildcat in Blue Lake Field in **Brazoria** County, productive from the **Frio** between 8000-11,000′. The #1 Willy will evaluate deep **Frio** sands and possibly penetrate the **Vicksburg.** About 1½ miles east, the McCarthy #1 Niedringhaus, a 13,640′ Frio gas discovery, logged several thin delta front type sands within a massive shale section from 11,750′ to TD. At the *Nodosaria blanpiedi* (middle Frio) horizon the wildcat spots near the crest of the faulted Blue Lake anticline.

In the southeastern corner of **Walker** County, CXY Energy has staked a 5500′ **Yegua** test 5 miles northwest of Jackson, Yegua, Cook Mtn. and Wilcox production at Old Waverly Field (San Jacinto County).The #1 McLelland Trust is 2 ½ miles west of the dry Getty #1 Keeland, a 20,827′ Woodbine test drilled in 1982. Top Yegua structure here appears to be southeast regional dip, based on very sparse control.

Farther southeast, in southwestern **Hardin** County, Samedan Oil will drill an 11,500′ wildcat 1½ miles northeast of abandoned Yegua gas production at Strain Field. The #1 Clubb will evaluate **Yegua** and deep **Cook Mountain** sands. At the top Yegua horizon the new venture spots on the steep northeast flank of the faulted Strain Field interdomal structure.

Weeks Exploration is continuing to develop their 1989 discovery in state waters off **Jefferson** County, about 5 miles south of the old Clam Lake Field. The ST 51S #2, ST 52S #1, #2 and #3, and the ST 60S #4 have all been successfully tested in the **lower Miocene** with flow rates up to 553 BOPD and 3,050 MCFGPD. First production from the new field commenced in August, with early rates in the range of 2,000 BOPD and 18 MMCFGPD.

South Louisiana

Richland Resources has staked a 13,100′ **lower Tuscaloosa** test about 2 miles southeast of Tuscaloosa production at Greensburg Field in central **St. Helena** Parish. The #1 Bridges spots near the crest of a small southwest plunging nose at the lower Tuscaloosa horizon. Sand development in the nearby Ashland #1 Morgan and McClinton #1 Cole dry holes suggests a possible stratigraphic trap at the new location.

Quintana Petroleum will drill its #1 SL 13567 between Fort St. Phillip and Buras Fields (upper Miocene) in southeastern **Plaquemines** Parish. The wildcat will be directionally drilled to a projected TVD of 9800′. At the *Tex 'L'* horizon the new test spots on south dip between an up-to-the-coast and a down-to-the-coast regional fault.

Farther south and just off the coast in state waters, Bass Enterprises has scheduled the #2 SL 192 almost a mile

northeast of West Delta-Block 27 Field (upper Miocene production from 8000′ to 16,200′). The outpost test, projected to 8500′ TD, should evaluate shallow sands on the northeast flank of the large, unfaulted Block 27 Field structure.

MESOZOIC TREND

East Texas

Lasmo Energy has scheduled a 12,500′ **Jurassic** wildcat in northern **Freestone** County, about a mile east of Woodbine, Rodessa, Pettet and Travis Peak production in the Rischers Store Field area. The #1 Bonner is about 3 ½ miles north of nearest Jurassic production at the Home Petroleum #1 Oransky, et al, discovery well for Banks Stop Field, which initially flowed 250 MCFGPD from Cotton Valley Lime perfs at 11,401-458′. At the top Smackover horizon the new test spots on steep east dip, upthrown to the southeast bounding fault of a northeast-southwest trending graben system associated with Jurassic salt movement.

North Louisiana - South Arkansas

OXY USA is currently drilling the first horizontal **Wilcox** test in Louisiana. The #13-1 Tremont H, located in Olla Field in northern **LaSalle** Parish, is projected to a vertical depth of 2300′, with a 1000′ horizontal section. Probable target is the **Cruse Sand,** productive in several OXY wells in the immediate area.

Fina Oil & Chemical will drill a 7700′ **Smackover** test in extreme eastern **Columbia** County, Arkansas, about 1 ½ miles northeast of Sligo oil and Smackover oil and gas production at Spottsville Field. The #1 Stratton is 2000′ north of the American Trading & Production #1 State, abandoned in the Smackover with no cores or tests reported. At the Smackover horizon the wildcat spots on a small nose (or possible closure) along regional south dip.

In the extreme southeastern corner of **Lafayette** County, Marathon Oil has completed the #1 Cart as a new **Cotton Valley** discovery, opening Salem Grace Church Field. Flow rate was 160 BOPD and 240 MCFGPD from 8740-58′. At the base Massive Anhydrite horizon the new producer spots on a broad, northwest plunging structural nose.

Alabama

Cobra Oil & Gas has completed a new **Smackover** oil discovery in the updip Smackover trend in northwestern **Escambia** County about 1¼ miles northeast of Pruet Production's East Huxford Field discovery, completed last January. The #2 ATIC flowed 344 BOPD and 658 MCFGPD from 14,278-292′. Top Smackover structure is irregular southwest regional dip, however, the new producer has most likely encountered another pre-Jurassic basement high.

Farther east, in extreme western **Covington** County, Torch Operating will evaluate the **Jurassic** section at a remote wildcat 1 ¾ miles north of the town of Rome, and 8 ½ miles north of nearest production (Haynesville) at the one-well West Falco Field. The #1 Paramount-Findley 5-2 is about 1700′ west of Amoco's #1 Campbell, D&A at 12,750′ in igneous basement after encountering the Smackover/Norphlet contact in a core at 12,113-185′ with no details released. At the top Smackover horizon the new test spots on moderate southeast dip in close proximity to the approximate updip limit of the Smackover.

GULF OF MEXICO

Provided by Dwight's, a SOFTSEARCH Company

Seagull Energy has announced a gas/condensate discovery at **Galveston** Block 273 in the Gulf of Mexico, approximately 20 miles south of Galveston, Texas. The #1 OCS G-9037 encountered six productive gas and/or condensate zones, two of which were tested. Flow rate was 2.9 MMCFGPD and 96 BCPD through perfs at 9642-54′, while perfs at 8764-80′ yielded 3.3 MMCFGPD. A second well is currently being drilled.

Dekalb Energy has announced results of its first significant success in the Gulf of Mexico. The discovery was drilled on **West Cameron** Block 406, 97 miles south of Lake Charles, Louisiana, and is operated by Corpus Christi Oil & Gas. The OCS-G 11789 reached a total depth of 11,360′ in a water depth of 89 feet. On a production test through unspecified perforations, the discovery flowed ARO 2.5 MMCFGPD.

INTERNATIONAL HIGHLIGHTS

Provided by PETROCONSULTANTS, Foreign Scouting Division, Geneva, Switzerland

LATIN AMERICA

Brazil (Onshore)

Petrobras spudded its wildcat 1-RCA-1-PR (Rio Cantu) in the **Parana basin,** about 72 km (44.7 miles) northeast of Cascabel. This is the first well drilled in the Parana basin since 1985 when BP concluded its exploration program. Planned TD is 4520 m (14,830').

Brazil (Offshore)

Petrobras reportedly has made a significant discovery at the 1-BSS-56 wildcat, the third made in the **Santos basin.** Tests were reportedly run, but no flow rates have been released. Preliminary estimated reserves assigned to the discovery are 150 million bbl oil and 280 BCF of associated gas.

EUROPE

Netherlands (Offshore)

Petroland's K/6-6 wildcat was successfully tested, flowing 14 MMCFGPD after fracturing. Further drilling is planned on the new find.

United Kingdom (Offshore)

Ranger's Anglia appraisal well 48/18b-9 tested 35 MMCFGPD from its horizontal section, significantly increasing the productivity of the reservoir. Development drilling was scheduled to get under way at Anglia late in 1990.

Turkey

Aladdin has suspended its Dusa 1 wildcat as an oil well in License 2682 in the **SE Anatolian basin,** about 10 km (6.2 miles) east of TPAO's Raman oil field. Test results were not disclosed.

Also in the **SE Anatolian basin,** TPAO has encountered oil in three wildcats: Yalinkavak Guney 1 in Lease 779, located close to the Sezsin Field east of Batman; Besikli Dogu 1 in License 2671, east of Adiyaman; and Araban 1 in License 2831, northeast of Gaziantep. The latter is probably the first discovery ever made in the area. Test results were not reported.

AFRICA

Egypt (Offshore)

Petrobel announced an oil discovery in the Belayim Marine development lease in the Gulf of Suez. Wildcat Belayim Marine Northeast 1, which bottomed at 3550 m (11,648') in Nubian sandstones, was completed as an **Early Senonian Matulla** oil producer.

Tunisia (Onshore)

Agip has spudded its first well in the Merzoug permit in west-central Tunisia. Hamadania 1, in the **El Djerid basin,** will be drilled to 3500 m (11,484') to evaluate **Triassic** sandstones. Earlier attempts in the area by Amerada Hess (Sabria 1 in 1962) and Amoco (Algueia 1 in 1983) were unsuccessful, although the latter did encounter oil in the Triassic.

Tunisia (Offshore)

Agip has also spudded its Hammamet Ouest 2, in the Enfidha permit, 35 km (21.7 miles) off the coastal city of Hammamet. The wildcat, which is located only 11 km (6.8 miles) from Agip's Maamoura oil and gas accumulation, will target the **Upper Cretaceous Abiod** formation.

Angola (Shelf)

Texaco has disclosed test results for two recent oil discoveries in the **Lower Congo basin** Block 2. Estrela 1, located 2.2 miles ENE of the Bagre 1 oil discovery (13,488 BOPD) and 32 km (19.9 miles) south of Soyo, yielded 2,129 BOPD (36.2° API) from a 30' interval in the **Albian Pinda** dolomites below 2376 m (7796'). Morsa West 1 flowed at a combined rate of more than 1,600 BOPD (36-37° API) from three zones between 1498 and 1544 m (4915-5066') in the **Albian Pinda** formation. The new find is 1 ½ miles SSW of the sub-commercial Morsa 1 oil discovery (1981) and 28.5 km (17.7 miles) WNW of Quinzau.

Gabon (Onshore)

Elf's wildcat Dianongo Avocette Sud 1, located 1 ¼ miles southwest of the Dianongo Avocette discovery in the Ogooue Dianongo exploration permit, tested 1,572 BPD of 36 API anhydrous oil from pre-salt **Aptian** clastics. Additional drilling will be required to evaluate the new discovery's potential.

NEAR EAST

Israel

Israel National Oil Company has initiated its seven-well program in the Dead Sea area with the spudding of wildcat Admon 1, located about 2 ½ miles SSW of Sedom in the Tamar (220) license in the **Dead Sea graben.** Projected TD is 2000 m (6562'), with the **Pleistocene** as the objective.

UAE-Abu Dhabi (Onshore)

In July 1990, Adco completed testing of the deeper pool wildcat Shah 20, located in the Shah Field, an Upper Cretaceous Simsima producer. The well flowed an aggregate of 745 BOPD (42° API), 44,500 MCFGPD and 840 BCPD (56-58° API) from four intervals in the **Upper Jurassic** and the lowest part of the **Lower Cretaceous.**

FAR EAST

China

An oil discovery was recently made in northwest China's Xinjiang Uygur Autonomous Region. In July 1990, wildcat Donghe 1 tested 2,466 BPD of light crude and 49 MCFD gas from an undisclosed interval. A 51' oil saturated core was later recovered, and at last report drilling was continuing towards the projected TD of 6300 m (20,670'). The drillsite is in the northern part of the **Tarim basin** between two other oil-bearing structures, Lunnan and Yingmai.

Indonesia (Onshore)

On South Sumatra, Asamera announced a gas discovery in the northern part of the Corridor block, where wildcat Gelam 1 tested an aggregate of 26,215 MCFGPD and minor amounts of oil and condensate from **Miocene Talang Akar** clastics.

On Tarakan Island off North Kalimantan, Pertamina suspended its wildcat Bunyu Sei Paya 1 as a gas discovery. In various drill stem tests, gas was recovered at a cumulative rate of 18,160 MCFD from **Miocene** and **Pliocene** clastics.

Indonesia (Offshore)

Occidental announced a gas discovery in its Berau block in the **Bintuni basin** off Irian Jaya. The Roabiba 1 wildcat tested up to 23,600 MCFGPD, presumably from a **Jurassic** sandstone reservoir.

Malaysia (Offshore)

Occidental has made an oil and gas discovery at the Bentara 1 wildcat in the southern part of the company's SK-6 permit, offshore Sarawak. Several oil and gas bearing zones were encountered between 2050 and 2650 m (6726-8695'), two of which were tested, flowing 1,200 BOPD (32° API) and over 9,200 MCFGPD, respectively. Pay zones are in the **Early Miocene Cycle II** formation.

AUSTRALIA

Western Australia (Offshore)

BHP's wildcat Scindian 1A in the **North Carnarvon basin** was suspended as an oil and gas discovery in October at total depth 3151 m (10,338'). Five RFTs were run between 2623 and 2653 m (8606-8704'), recording, respectively, a high 8,312 cu ft/bbl oil, gas and water, and a low 759 cu ft/bbl oil gas and water. Woodside's Yodel 1 wildcat **(Carnarvon-Dampier basin)** was also completed in October as a gas and condensate discovery after testing at a stabilized flow rate of 20,700 MCFGPD and 2,695 BCPD from 2955-2965 m (9695-9728').This latest find is 2.2 miles south of the operator's 1988 Echo 1 discovery (3,858 BCPD and 15,500 MCFGPD) and adds to the string of successes Woodside has been scoring recently.

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Walter Wornardt, Ph.D. President, MICRO-STRAT INC., Adjunct Prof., Rice Univ.

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Adam's Mark Hotel, 2900 Briarpark Dr. at Westheimer

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- High Resolution Biostratigraphy principle and practices
- Utility of high resolution biostratigraphy in recognition of condensed sections, sequence boundaries, systems tracts and geologic age
- Interpretation of paleoenvironments and lithofacies from well log pattern
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The session is limited to 50 participants from oil companies or independent geological/geophysical consultants.

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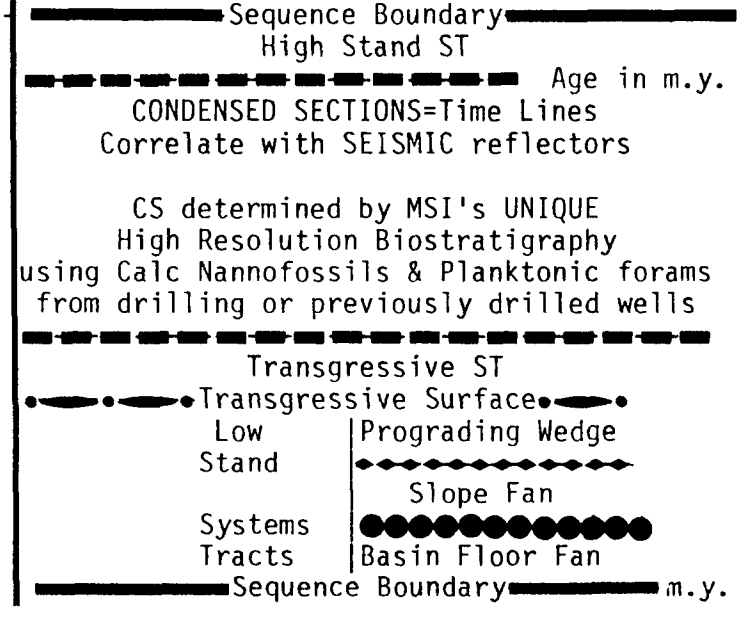

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