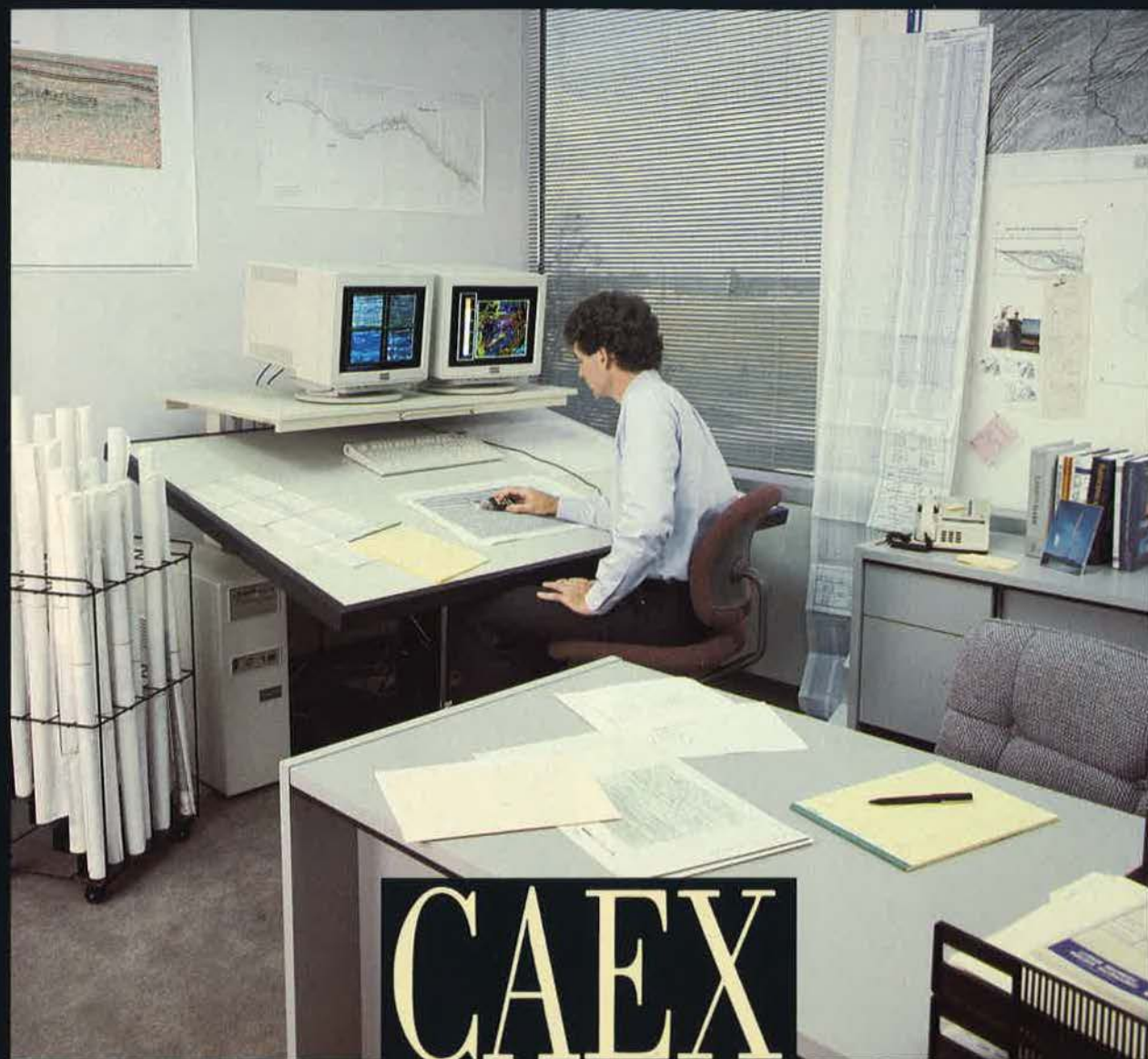


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JANUARY LECTURE

"Interactive Interpretation of a Submarine Fan Offshore Ireland, A Case History"



H. ROICE NELSON, JR.
Landmark Graphics Corporation

AUTHORS:

D. Bradford Macurda, Jr. (The Energists)
and

H. Roice Nelson, Jr. (Landmark Graphics Corporation)
(Speaker)

ABSTRACT

The Porcupine Basin, off the southwest coast of Ireland, is a large Lower Cretaceous rift basin with up to eight kilometers of sedimentary fill. From a wide variety of environments, and the associated stratigraphic plays and traps, we present a detailed interactive interpretation of a submarine fan from a series of Eocene alluvial fans or fan deltas along the eastern basin margin.

The stratigraphic succession is divisible into 9 or 10 super-sequences; there are 29 or 30 sequences in the Tertiary alone. Mapping these sequences by conventional techniques is a time consuming task. Once the sequence boundaries have been recognized and verified by loop tying on CDP record sections, it is possible to use a workstation to greatly speed up seismic facies analysis and mapping procedures. Displays of both amplitude and phase bring out significant differences in the depositional history and facies of the sequences.

Deltaic progradation into the basin occurred into the Tertiary. A significant deepening of the basin also took place at this time. The development of a series of prominent submarine fans provides a challenging exploration problem. Where are the reservoir prone facies best developed? And where would the hydrocarbons be trapped? Amplitude and phase sections reveal significant variations within the fans and subsequent sealing by onlap fill deposits. Mapping of the sequences within the fans portrays their structural attitude and how drainage would occur.

Landmark will be providing a workstation for detailed evaluation of the data by those attending that are interested, and we plan to spend the afternoon following the luncheon talk working on the system with those interested.

BIOGRAPHICAL INFORMATION

Dr. Macmurda was a Professor in the Department of Geology and Mineralogy at the University of Michigan in Ann Arbor, Michigan from 1963 to 1978. He worked at Exxon Production Research Company from 1978 to 1981, and since that time has worked for The Energists.

Mr. Nelson was a founder of Landmark Graphics Corporation in 1982. For the three years prior to that he was General Manager of the Allied Geophysical Laboratories at the University of Houston and a Senior Research Scientist at the Seismic Acoustics Laboratory. He worked at Mobil Exploration and Production Services, Inc. in Dallas, Texas from 1974 to 1980, and had two summers experience at Amoco Production Co. (Pan American) in Denver, Colorado.

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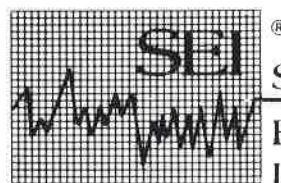
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The SGS is publishing a much larger, more informative monthly magazine "Reflections". Reflections is the society's forum for news articles, company information and editorial opinions. In addition, an annual membership directory is mailed to each member.

AWARDS AND SCHOLARSHIPS

The SGS presents awards to professionals who have made outstanding contributions to the society and the scientific community. Scholarships to deserving students of geophysics are also awarded on an annual basis.

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The cost of annual membership is only \$10.00 and includes the following at no extra cost:*

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- 3) Discounts and Continuing Education courses
- *4) Monthly Luncheon Meetings (\$13.00 at door)

COMMITTEE CALL

In planning for the 1987-88 year, the SGS officers request your participation in the organization of our upcoming year's program. If you would like to get involved in the Society's functions in any of the below committees, please contact our newly elected president, Mr. Dick Cole at 592-6414.

- | | |
|------------------------|-----------------|
| — Arrangements | — SGS Directory |
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SGS MEMBERSHIP RENEWALS

Now is the time to renew your SGS Membership if you have not done so already. If there is a (**) on the mailing label of this newsletter you have not yet paid your dues for the 1986-87 year. This reminder will be repeated in the next newsletter as well, but after that all unpaid members will be dropped from the mailing list. Additionally, only members of good standing by the end of September will be listed in this year's directory. Also remember there is a reduced registration for the Christmas Dance and Golf Tournament for SGS members.

Any questions about your membership may be directed to SGS Membership Chairman George McMillan at 586-6603. Membership forms may be obtained from George, your SGS Company Representative or at the Luncheon.

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INDEPENDENTS IN THE GULF

New players are standing in line to test the waters of the Gulf of Mexico, a Houston consultant said. "Companies (independents) have really been calling in lately wanting to know how to get into taking farmouts in the OCS," says consultant Jodi Conner of J. Conner Consulting. Operators were extremely cautious in the first half, but now feel the \$18/bbl price is a benchmark. Since many drilling budgets were predicted on \$15/bbl oil, more cash is being earmarked for exploration to enhance declining reserves and take advantage of low drilling costs. Furthermore, independent oil and gas producers ranked a guaranteed minimum wellhead oil price as the economic incentive that would have the greatest impact on their drilling plans, according to a survey conducted recently by the accounting/consulting firm of Ernst & Whinney. Kenneth M. Burke, national director of energy industry services, said, "Independents responding to our survey said on average they plan exploration and development spending of about \$1 billion in 1987 and 1988, if prevailing economic and regulatory conditions do not change. But, they would increase their plans by an average of about 50% for both years if a \$28/bbl minimum wellhead price were established." Other incentives the independents deemed important, though to a lesser degree, were a 10% energy security tax credit on total E&P expenditures and a revision in the alternative minimum tax that would exempt IDC and excess percentage depletion as tax preference items.

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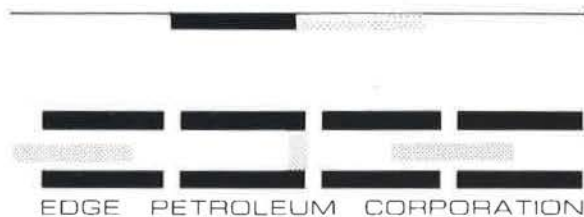
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SEISMIC GATHERING ALTERED TO OBTAIN BETTER DATA

Seismologists altered conventional exploration data gathering procedures recently to improve the data quality under specific conditions. Saga Petroleum and Geco employed two seismic cables deployed vertically, or one above the other, to improve data gathering in poor weather conditions. The companies say the ability to operate in adverse North Sea weather conditions significantly extends operating time. Also, Conoco and Tensor Geophysical Service shot seismic using concentric paths at expanding radii around a central point, instead of conventional parallel lines. The process was used to better image the flanks and faults surrounding a salt dome in the Gulf of Mexico.



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SURVEY SHOWS YEAR-END ACTIVITY KICK

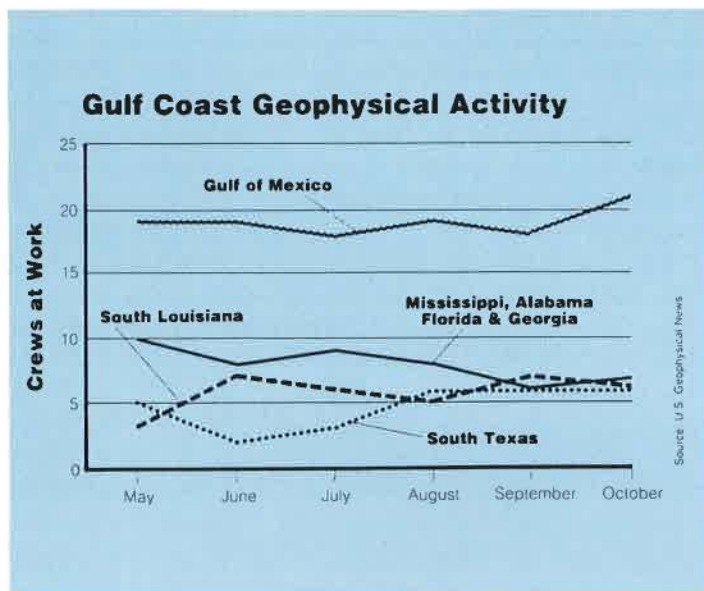
Gulf Coast Oil World's annual Geophysical Survey has uncovered a strong kick of year-end activity for the region's contractors in 1987.

Most of the work going on this fall was proprietary in nature and won't be found on the accompanying chart. But there is growing optimism that the geophysical industry has followed the petroleum industry around the corner.

"Things are turning around a little bit," confirms Tim Moran, of Seismic Exchange, Inc.

A sign of increasing activity is a tightening labor market for field hands. "It's getting tighter," says Moran. "In 1986 you could pick up the phone, get your bid and say 'be out there Monday.' And they'd be out there Monday. Now you've got to get on the scheduled. They've got so much work backing up."

In fact, data from *U.S. Geophysical News* shows activity during the last six months has been fairly steady in Gulf Coast areas, with a hint of an upturn in October (see graph). Activity in the eastern Gulf Coast states has been especially strong, despite a drilling slowdown in 1987. In October, seven geophysical crews were at work in the eastern states of Mississippi, Alabama, Georgia and Florida.



U.S. SEISMIC CREW COUNT¹

Participants	LAND CREWS		MARINE VESSELS	
	Sept. 1987	Sept. 1986	Sept. 1987	Sept. 1986
43 contractors	151	114	26	20
7 oil companies	13	17	3	4
1 government	0	0	0	0
TOTAL	164	131	29	24

¹Society of Exploration Geophysicists 9/87



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OIL PRICES FAIL TO RISE AS VIOLENCE INCREASES IN PERSIAN GULF

The sharp escalation in Persian Gulf hostilities late last month caused jitters in world oil markets but did not run up prices as many observers had expected. Several considerations may explain the markets' relative stability. First, resilient suppliers continue to devise ways to maintain exports, despite damage to facilities and risk to life and property. Second, excess production capacity ensures that exports cut off from one source will quickly be picked up by another. And third, it may be that the effects of supply disruptions are already factored into present markets, so that prices are in fact propped a few dollars higher than they would be in more peaceful circumstances.

(Ocean Industry, Nov. 1987)

GAS PRICE OUTLOOK

If a return of prosperity to the Gulf of Mexico depends, as many people believe, on an increase in natural gas E&P activity, a recent report from the American Gas Association comes as dismal news. AGA predicts gas prices will fall during the next two years and then increase, if at all, only at the rate of inflation in the 1990s. Despite low prices, AGA says U.S. gas supplies will remain more than adequate through 2010, with consumption rising from today's 17 tcf to 22 tcf by 2000.

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NATIONAL ENERGY POLICY / OIL TARIFF

Texas Governor Bill Clements said his recommended establishment of a national energy policy would result in oil prices stabilizing between \$20-\$25/bbl. "I think that in the interest of national security and economic good health, we need to come up with a mechanism to deal with the overproduction in the Middle East," Clements said recently.

Market "imperfections" associated with U.S. oil imports means that American consumers pay only part of the cost of foreign petroleum that fuels their cars, homes and industries, according to a Harvard University study titled "Energy Security Revisited." The current price U.S. consumers pay for imported oil "does not reflect the true, or social, cost to the nation of dependence on insecure supplies," the study says. The difference is made up by indirect, tax-supported subsidies, largely in the form of military expenditure. As a result, Americans consume more oil than is optimal. To correct skewed market conditions, the study recommends a tariff on imported oil of \$5/bbl, a politically acceptable figure, although \$10/bbl would be economically more appropriate. The study sharply criticized Reagan administration opposition to an oil import fee and Department of Energy calculations that a \$10/bbl fee would cost Americans \$200 billion over a decade.

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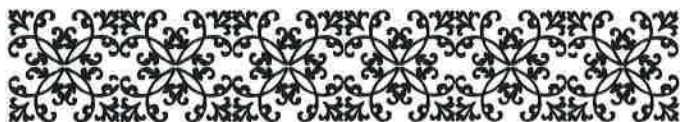
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FEDERAL BRIEFS

WHITE HOUSE — NO HELP

The administration during President Reagan's final year will not endorse tax breaks for drilling, nor will it advocate an import fee, said Deputy Energy Secretary William Martin. His remarks to an energy security study group came a week after Harvard University released a study that calls for a \$5 import fee and repudiated DOE's study claim that a \$10 fee would excessively penalize the U.S. economy. Energy Secretary John Herrington earlier this year had pledged to oilmen that he would help garner restoration of depletion allowances and other tax breaks.

EPA MAY NOT REGULATE WASTES

The Environmental Protection Agency reportedly will not recommend that wastes derived from oil and gas operations be declared hazardous. The report comes on the heels of an environmental study on the subject that will be presented to the U.S. Congress before Dec. 31. The EPA was asked to examine such wastes as cuttings and produced water to determine if they should be declared hazardous. The EPA is expected to make a formal recommendation next summer.

WINDFALL PROFITS TAX

Repeal of the windfall profits tax on domestically produced crude oil could save American consumers as much as \$30 billion yearly, the president of the American Petroleum Institute said. "Repeal is in the interest of consumers in all regions of the country, simply because repeal will stimulate domestic oil production, reduce demand for OPEC oil and thus put downward pressure on world oil prices," Charles J. DiBona said.

GULF REEF MAY BE PROTECTED

The Flower Garden Banks, the only live coral reef in the northwest Gulf of Mexico, may be granted national marine sanctuary protection in 1989. An administrator with the National Oceanic and Atmospheric Administration has been quoted as saying the designation is being "actively pursued." The reef is located 120 miles southeast of Galveston, Texas.



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DRILLING ACTIVITY

Drilling Activity continues to gain during the last quarter of 1987 with 422 working rigs (worldwide) compared to 413 last month. In the Gulf of Mexico activity rose from 100 to 104 in Louisiana, from five to eight for the Mafla area and from 18 to 20 off the coast of Texas. Submersibles saw the highest increase in utilization, rising 6.2% from last month's 18.8%. Semisubmersible and jackup utilization rose 1% with drillships dropping 4.5% and drill barges remaining the same. Five U.S. companies made a showing for top operator this month. Chevron and Shell both placed in the second position with 21 wells. Amoco and Mobil had 15 wells as the number four operator. Texaco was a new entry in the number five position with 14 wells currently drilling.

The need to drill leases set to expire in 1988 and an influx of eager new participants are accelerating activity in the Gulf of Mexico to the point that reports are now being heard of shortages of certain supplies, equipment and personnel. The tightest market is in support vessels for deepwater drilling, but cantilever jack-ups are not far behind, and nervous operators are bidding up dayrates and inquiring about one-year contracts. The upturn has worked off surpluses of drillpipe and casing in larger sizes. The pool of experienced skilled workers is running dry, and many companies are having to hire trainees.

Nervous smiles were in abundance at the recent International Association of Drilling Contractors' annual gathering in Houston. While most of the more than 300 attendees were applauding the seemingly stabilized oil price, they were warned the road will continue to be a bit more rocky in the future. Industry experts at the meeting generally believe oil prices will remain in the \$18-\$20/bbl range until 1990. Surprisingly, the most optimistic view came from one of the industry's harshest critics. Amarillo, Texas oilman T. Boone Pickens, general partner of Mesa Limited Partnerships, believes oil prices will continue their gradual increase, climbing to \$22-\$24/bbl by early 1988 and to \$25-\$28/bbl by mid-1989.



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SERVICE COMPANIES MAY PROFIT IN '88

Profits should reappear within the oilfield services sector as early as next year, says the president of Reed Tool Inc. Speaking in Houston recently, Roy Caldwell said "the worst is over for the U.S. drilling industry and 1988 may see a return of the oil service industry to profitability."



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CAEX FOR EVERY EXPLORATIONIST

By: Sara K. Stewart
Landmark Graphics Corporation

Computer-aided Exploration and Production (CAEX) technology has emerged in recent years as a result of the need to efficiently interpret the massive amounts of data generated from 3D surveys. Initially adopted to address data management problems associated with these large surveys, interactive tools gained acceptance as the accuracy of resulting interpretations improved. To date, CAEX has proven to be an integral tool in field development where the associated risks and costs are high. Many of the world's major oil companies have successfully used interactive interpretation to develop fields in areas of deep water, complex structure and stratigraphy, including the Gulf of Mexico.

While acceptance of CAEX technology quickly gained momentum in the 3D seismic arena, expansion to other interpretation problems has been limited. In the past, vendors took the approach of addressing other interpretation problems by merely adding software applications for 2D seismic and other types of data to existing 3D workstations. This approach did not expand interactive technology usage to exploration projects beyond 3D for several reasons. First, the backlog and high cost associated with 3D projects made 2D projects and other applications a lower priority, leaving little system time for projects other than 3D. Secondly, manual techniques could adequately address other data interpretation problems—there was no compelling need to utilize an interactive workstation. Additionally, workstations configured for 3D were too expensive (typically ranging between \$200,000-\$300,000) for dedication to daily exploration tasks.

To expand interactive technology to every day usage, a system is needed that offers technical solutions specific to exploration tasks at an affordable price. Several requirements are necessary for acceptance of interactive tools for new applications. These include:

- **Data access**—Data must be quickly and easily accessed so explorationists can concentrate efforts on interpretation and mapping. Too much time spent on complex data loading bottlenecks exploration prospecting. For instance, many oil companies work on a variety of short-term projects such as lease sales and farm-in proposals, that require streamlined data loading.
- **Easy integration of different media and vintages of data**—Since the majority of data still exists on paper (2D seismic, maps, and well logs), both paper and digital data must be accessible through the interpretation system. Paper information should be easily accommodated when exploration data is not available on tape or when the data is impractical to conform to graphics screens. For example, an explorationist might integrate long regional paper sections with digital data to gain both regional and prospect level perspectives.

Another critical issue is raised when combining various vintages of 2D data—the need to accommodate discrepancies in acquisition, processing, or format between different vintages and contractor data. It is essential that explorationists have a variety of ways to analyze and eliminate the misties that result from these differences.

- **Ease of use**—In order for a broad range of individuals to achieve the benefits of interactive interpretation, the technology must be easy to use, minimizing learning time. Ideally, the system should be designed to require no computer experience for the explorationist to become productive almost immediately.
- **Integrated functionality**—Oil companies, realizing the benefits of integrating the work of earth science specialists, are striving to more tightly couple the various geoscience disciplines. The workstation can provide a convenient vehicle to achieve this goal by serving as the common tool for petroleum explorationists. The interactive system should, therefore, encourage integration of geophysical, geological

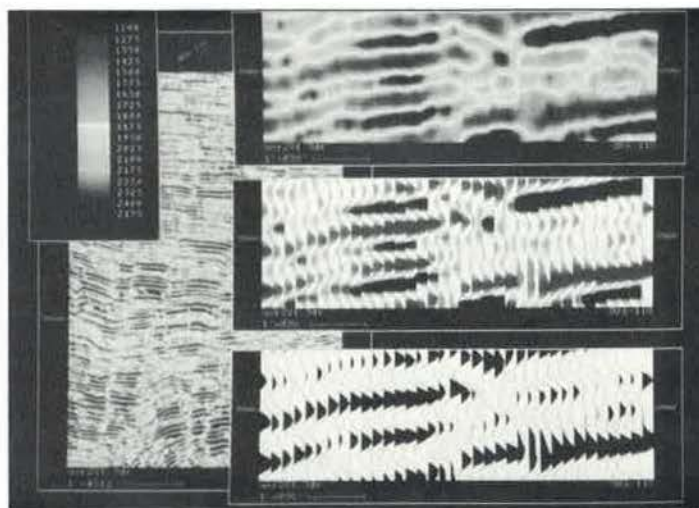


Figure 1. Many InterpreterPlus capabilities are the direct result of Gulf Coast customers' requests. User-defined windows enable explorationists to segment the screen to view various data displays simultaneously. For example, a new seismic data display, VariFill(TM), combines features of both variable density and wiggle trace displays.

and engineering disciplines and their data.

- **Appropriateness for the interpreter's workplace**—The real benefits of CAEX technology—improved accuracy of interpretations by testing multiple alternatives—require unimpeded access to the system. Thus, a system must be properly packaged and available at a cost appropriate for the explorationists' workplace. Familiar tools of the trade, such as paper seismic lines, maps and well logs, must be incorporated so the workstation becomes a personal interpretation tool.
- **Enhanced productivity**—The measure of effectiveness of an interpretation system is not based on the level of savings in terms of man-hours. The real benefits of workstations are the improved confidence level of interpretation accuracy that help explorationists reduce risks associated with drilling decisions.

Responding to customer input, Landmark has recently developed a new product, InterpreterPlus (TM), to assist in the daily tasks performed by all explorationists. Incorporating its experience with interactive technology and the expertise of hundreds of Gulf Coast CAEX users, Landmark took a new approach to address the issues necessary to expand usage to new applications. InterpreterPlus, a second product family of workstations, makes interactive technology viable to more explorationists by uniquely meeting requirements previously unavailable with computer-aided tools at an affordable price.

As oil companies strive to become more cost effective, they must address issues of additional risk associated with more difficult exploration efforts and more challenging economic circumstances. Today there is an opportunity to expand CAEX technology and benefits to those explorationists who have not yet had access to such tools, providing them a means to improve confidence in accuracy of analyses and facilitate critical decisions.

INTERNATIONAL BRIEFS

OPEC AT 60% CAPACITY

Australia's BHP Petroleum, which places emphasis on petroleum demand rather than price, says OPEC is now producing at about 60% capacity. Production levels will drift upward to match demand between 80% and 90% by 1990. Until then prices are likely to remain in the \$16-\$20/bbl, but by the early 1990's capacity and demand will be in closer balance and prices should firm, the company predicts. In the past year, BHP has gone from having one exploratory well actively drilling to 12 as of October.

BAY OF CAMPECHE WELL BLOWS OUT

The U.S. Coast Guard confirmed that the Yun oil well, operated by Mexico's Petroleos Mexicanos, had blown out in the Bay of Campeche on Oct. 10, creating a major oil spill stretching 55 miles west of the rig. About 4,000 bopd were spilling into the slick, which was drifting toward the western side of the bay. The site is in the same area as the infamous 1979 Ixtoc I blowout, which spilled 3.1 MMbbl over nine months. At press time, workers were still trying to kill the well.

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MEXICAN PRODUCTION NEAR (PEAK) CAPACITY

Sources close to the Mexican oil industry are said to believe that state oil company Pemex is producing at or only slightly below capacity. According to Platt's Oilgram News, local analysts think Pemex production capacity declined along with investment during 1986 from 2.5-million-bpd levels in 1985, so that the 2.532-million-bpd average for the first eight months of this year now represents a near-peak rate. If the analysts' views are correct, Pemex would be unable to pump extra oil to help counter a Mideast supply disruption.

1-D...2-D...2½-D...3-D...4-D...

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by Rosann Hooks

Talk about fraternal fun and frolic! That combined with the music and good food made for a great evening for the SGS/NOGS Christmas Party at the Jefferson-Orleans on December 5. Favors for the ladies were pot pourri in lace tree ornaments made by both auxiliaries. The talented gals on our side were: Fran Bailey, chairman, Rose Carbone, Phyllis Nash, Liz Kreider, Laverne Nuttli; and our glorious leaders Jean Stewart and Doreen Cole. And my thanks to Mary Petrocco for supplying the information about the party and also for taking photos which you will see next month.



NOVEMBER COMMITTEE

Left to right, Gldays King, Tee Richard, Barbara Reed. Not pictured Ann Nick, Chairman.



At Railroad Museum in Kenner Rivertown.



Left to right, Joyce Taff, Claudia Marquis, Carol Kreider and LaVerne Nuttli. Door prize winner Claudia Marquis is holding loaf of homemade bread.

Walking shoes were welcome the day a group of about 30 Auxiliary members took the tour of Rivertown led by Lillian Reed from the Office of Tourism in Kenner. The predicted rain never came and most of the members seized the opportunity to purchase something along the way in one of several antique shops we visited. Lucky door prize winners at the luncheon were: Betty Hazen, Florrie Kornovich, Claudia Marquis, Frankie Loui Murray, Mary Allen Warrick and Flo Wilcox. The prizes were homemade loaves of bread, part of the table decorations, and were made by Cafe Alexander owner Anne Gauthier.



Imogene Heffner, left and Jean Stewart, right at Railroad Museum.

LOOKING FORWARD TO....

January 21, 1988 will be a special event. The 30th Anniversary Luncheon for the SGA will be held at Commander's Palace at 11:30 A.M. Chairman for this luncheon, Rosemary Austin, says it will honor past presidents of the Auxiliary. Don't miss seeing good friends and eating good food.

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LAND MARK

November 2, 1987

David Muerdter
Amoco Production Co.
1340 Poydras Street, Room 1221
New Orleans, Texas 70113

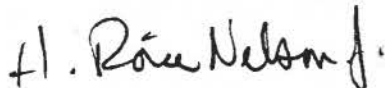
Dear Mr. Muerdter:

This letter is to document our phone conversation Friday. I will speak at the January 5th luncheon of the Southeastern Geophysical Society. The talk requires two 35 mm slide projectors with carousels, as well as two screens. I anticipate that someone else from Landmark will also attend, but schedules are not firm yet. As soon as they are, we will call.

Landmark will be providing a workstation for detailed evaluation of the data by those attending that are interested, and we plan to spend the afternoon following the luncheon talk working on the system with those interested. The workstation requires one (1) duplex 15 amp outlet. It is our understanding that you will make arrangements with the hotel for extended use of their seminar room.

Thank you, and we look forward to the presentation.

Best Regards,



H. Roice Nelson, Jr.
Vice President

✓/marti

cc: Richard Barren
John Harris
Gene Ennis
Brad Macurda
Richard Todd

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Interactive Interpretation of a Submarine Fan Offshore Ireland, A Case History

D. Bradford Macurda, Jr. (The Energists) and
H. Roice Nelson, Jr.* (Landmark Graphics Corporation)

ABSTRACT:

The Porcupine Basin, off the southwest coast of Ireland, is a large Lower Cretaceous rift basin with up to eight kilometers of sedimentary fill. From a wide variety of environments, and the associated stratigraphic plays and traps, we present a detailed interactive interpretation of a submarine fan from a series of Eocene alluvial fans or fan deltas along the eastern basin margin.

The stratigraphic succession is divisible into 9 or 10 super-sequences; there are 29 or 30 sequences in the Tertiary alone. Mapping these sequences by conventional techniques is a time consuming task. Once the sequence boundaries have been recognized and verified by loop tying on CDP record sections, it is possible to use a workstation to greatly speed up seismic facies analysis and mapping procedures. Displays of both amplitude and phase bring out significant differences in the depositional history and facies of the sequences.

Deltaic progradation into the basin occurred into the Tertiary. A significant deepening of the basin also took place at this time. The development of a series of prominent submarine fans provides a challenging exploration problem. Where are the reservoir prone facies best developed? And where would the hydrocarbons be trapped? Amplitude and phase sections reveal significant variations within the fans and subsequent sealing by onlap fill deposits. Mapping of the sequences within the fans portrays their structural attitude and how drainage would occur.

*Speaker

Bioiographical Information

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10260 Westheimer Suite 300
Houston, TX 77042

Dr. Macurda was a Professor in the Department of Geology and Mineralogy at the University of Michigan in Ann Arbor, Michigan from 1963 to 1978. He worked at Exxon Production Research Company from 1978 to 1981, and since that time has worked for The Energists.

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Mr. Nelson was a founder of Landmark Graphics Corporation in 1982. For the three years prior to that he was General Manager of the Allied Geophysical Laboratories at the University of Houston and a Senior Research Scientist at the Seismic Acoustics Laboroatory. He worked at Mobil Exploration and Production Services, Inc. in Dallas Texas from 1974 to 1980, and had two summers experience at Amoco Production Co. (Pan American) in Denver, Colorado.

Due to Dr. Macurda's other commitments, Mr. Nelson will give the presentation: Interactive Interpretation of a Submarine Fan Offshore Ireland, A Case History.