Geophysical Society of Houston

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History of Information Technology in Petroleum Exploration & Production

Jay E. Valusek

As an industry, petroleum exploration and production (E&P) is less than 150 years old. The first real oil production came in the mid-1850s from hand-dug pits in the Carpathian mountains of eastern Europe to fuel a growing kerosene industry. In 1859, Colonel Edwin Drake drilled his famous oil well in Titusville, Pennsylvania, officially launching the age of petroleum. One hundred years later, computers first made their way into the oil patch, sparking an information technology revolution. Today, there are over three million oil and gas wells in the world, and technological advancement continues at a dizzying pace.

This paper paints a picture of petroleum computing technology in broad strokes, to place current trends in clearer perspective. Two major periods of information technology in oil and gas are identified: the Mechanical Age, which ended around 1950, and the Digital Age. The Digital Age is further divided into three eras: the Era of Centralized Computing (c. 1956 - 1981), the Era of Personalized Computing (c. 1981 - 1990), and the current Era of Networked Computing (post-1990).

The Mechanical Age

Thousands of years ago, Middle Eastern civilizations encountered surface deposits of petroleum seeping up along deep fractures or out of the roofs of eroded traps. They called the sticky, flammable substance “pitch” or “naphtha,” and used it for medicine, waterproofing, and occasionally fuel.

Also around 3000 BC, probably in Babylonia, the first computing device in human history—the abacus—was invented. Beginning in the mid-1600s, inventors created a series of mechanical calculating machines consisting of complex gears and dials. Originally they could add only; but by the early 1800s, they were capable of performing all four arithmetic functions. Punch cards were introduced in the 1830s. By the late 19th century, businesses and government began using these mechanical devices more routinely to tally census figures and track financial data. International Business Machines was formed in 1924.

Early E&P Technology. Since its origins in the mid-19th century, the petroleum industry grew rapidly using mostly surface reconnaissance and mapping techniques. One of the first true “information technologies” in the oil business evolved from early seismic techniques developed during World War I to locate enemy bunkers. In the 1920s, the first seismic survey was shot, and the first oil field discovered using the new technology.

Also during the same decade, the Schlumberger brothers recorded the first well log in history. Over the next several decades, electric well logs became widespread. Petroleum engineering techniques became well established. Reservoir, production and economic calculations were performed either by hand or with the aid of a slide rule.

Early Computing Technology. The modern era of electronic computing technology began in the 1930s with the invention of the vacuum tube. By 1940, the first all-electronic computer had been invented. During World War II, the U.S. government funded a considerable amount of research in computer

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GEOPHYSICAL SOCIETY OF HOUSTON

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Technical Breakfast

Pore Pressure Prediction from 3D Seismic Data

Tuesday, May 13, 1997, "Northside" Technical Breakfast. Rick Lindsay of Diamond GeoScience, Tulsa OK, will finally have an opportunity to present his ice-delayed presentation from January, "Pore Pressure Prediction from 3D Seismic Data". The event will take place at Mobil's Greenspoint location, 12450 Greenspoint Drive. Full hot breakfast at 7:30 am, Speaker at 8:00 am. There is no charge to attend. This event is generously underwritten by Mobil. Reservations to the GSH office at 713/785-6403 by noon Monday, May 12.

Interactive Workstation SIG

Date:	May 8, 1997
Time:	4:30 PM
Place:	SCHLUMBERGER GECO-PRAKLA, 1325 South Dairy Ashford Third Floor, Room 3400. Visitor Parking is in the rear of the building.
Cost:	No charge; however, please reserve a place by calling the GSH Office (713-917-0218) no later than noon Tuesday, May 6. Seating is limited. A meeting of the SIG Committee will be held at 4:00 PM prior to the presentation. All committee members are urged to attend.
Topic:	Subsalt Computer Modeling; Using Ray tracing to Sort out the Distortions
Speaker:	Dr. David Muerdter Diamond Geophysical Research Corporation

Abstract:

Modeling is crucial in determining the seismic illumination beneath salt. I have used a 3D ray tracing to determine the distortion caused by the complex salt structure, especially at the edges of the salt bodies. Besides showing reflection point gather results, the presentation will discuss the challenges of using currently available software to accomplish the modeling.

Potential Fields SIG

Date:	Thursday, May 22, 1997
Time:	5:30 - Social Hour, 6:30 - Dinner, 7:30 - Talk
Location:	NEW Hess Building, 5430 Westheimer Formerly the Carlyle Restaurant Located on the north side of Westheimer between Chimney Rock and Yorktown.
Cost:	$20.00
Reservation:	Chuck Campbell, ACCEL Services, Inc. campbell@neosoft.com, or 713-993-0671
Topic:	Absolute Gravity: Current status and future plans
Speaker:	Timothy M. Niebauer, Micro-g Solutions

Abstract:

Absolute gravity is measured by monitoring the free-fall acceleration of a test mass in an evacuated chamber. The test mass of the absolute gravity sensor contains a freely-falling retroreflector which reflects a stabilized laser beam to form the variable arm of an optical interferometer. A stabilized laser and precise timing using an atomic clock tie the measurement directly to reproducible standards of length and time. Absolute gravity provides a perfectly calibrated value which can be reproduced by any instrument at any later time without uncertainties due to drift or tares.

The scientific methods necessary to measure absolute gravity have been under development by scientists for over the last 40 years in various standards laboratories around the world. In 1991, the state of the art was transferred to the private sector via a Technology Transfer from the US National Institute of Standards and Technology (NIST) in the form of a very accurate and precise gravity meter called FG5. The development has continued and been expanded to meet the needs of the current commercial customers. Over the past five years, the absolute gravity sensor has become much more rugged and has also seen dramatic reductions in size. At the same time, the sensor has become even more accurate and precise than it was when it was transferred to the private sector. Absolute gravity sensor technology is maturing rapidly and plans are now under way to repackage the sensor so that it can be as small and easy to use as relative gravity meters.

In addition to smaller absolute land gravity meters, this technology can also be used as the primary sensor for many other new instruments. For example, it can easily be reconfigured to measure absolute gravity gradients. As with absolute gravity, an absolute gravity gradiometer has perfect calibration without built-in mechanisms for drifts or tares. The absolute gravity gradiometer also provides a very large bandwidth extending from DC measurements over many years to quite short measurements taking only fractions of a second.

Data Processing SIG

Date:	Wednesday, May 21, 1997
Time:	Social, 4:00 p.m. Presentations, 4:30 p.m.
Location:	EPR, 3120 Buffalo Speedway, between Richmond & Alabama
Cost:	No charge
Topic:	Tomographic Inversion
Speakers:	Patrice Guillaume, CGG Bin Wang, Mobil
Organizers:	Guillaume Cambois, CGG Jerry Kapoor, Western

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First talk: Velocity model building using 3D tomographic inversion of multiple-arrivals: A North Sea example.

Authors: Patrice Guillaume, CGG France, A. Aamodt, P. Lanfranchi, L.T. Langlo, CGG Norway

Abstract:

Depth imaging requires accurate velocity macro-models in order to produce reliable results. Tomographic inversion has been proven to be a useful tool to derive models where velocity layers are separated by depth horizons corresponding to the main velocity contrasts. This is particularly interesting within the frame of the layer-stripping methodology (Jones, 1993, 1995).

Since tomographic inversion derives models that fit an observed dataset, it is clear that the overall effectiveness of the process is limited by the reliability and accuracy of this dataset. In the case of gentle tectonics, a portion of a reflector produces a single reflection arrival. Since we deal with pre-migrated data, more complex geological structures generate multiple-arrivals. If we want to accurately model these features, multiple-arrivals have to be taken into account in both observed data and inversion algorithm.

The method we propose here is a two step iterative process. First, a 3D ray-tracing is performed through an initial model (set of depth interfaces separating velocity fields). From this ray-tracing, we can compute stacked times (Ts) and stacking velocities (Vs). Then, residuals (differences between computed Ts & Vs and the observed Ts & Vs) are minimized via iterative updates of the initial model parameters. In these successive models, the depth interfaces are synthesized using triangulated surfaces generated by the GoCad 3D modeler (Mallet 1989). The velocity fields are modeled using B-spline coefficients.

This global scheme has to be adapted to handle multi-arrivals. First, the time picks are grouped into a set of single-arrival events (observed Ts), and each event initiates a ray tracing run that produces the corresponding computed Ts. Then we have to ensure that the observed multi-arrivals are compared to the corresponding computed multi-arrivals. To do that we have implemented an automatic discrimination method based on the quality of the hyperbolic fit and on a reflection point smearing analysis.

This technique has been applied to a North Sea dataset where the main objective was to image the pinch out of the BCU (Base Cretaceous) against a salt dome. Compared to a single-arrival technique, our approach provided an improved model and thus a better imaging of complex geological structures.

Second talk:: "Macro velocity model estimation through Model-based Globally-optimized Depth Focusing Analysis"

Authors: Bin Wang, Keh Pann and Jeff Malloy, Mobil Technology Company.

Abstract :

Existing Depth Focusing Analysis (DFA) (Fay and Jeannot, 1986; Willis, 1990; and MacKay and Abma, 1992) has three known limitations: small reflection dip, small offset, and locally-constant velocity. Due to these limitations. DFA is not able to handle complex over-burden problems for velocity model estimation. In the case of strong horizontal velocity variation. DFA may not converge to the true velocity model (Audebert, 1991; MacKay and Abma, 1992).

To overcome these difficulties, we propose in this presentation a new Model-based Globally-optimized Depth Focusing Analysis (MGDFA). The algorithm of MGDFA is founded on a new model-based interpretation of focusing panel. With this interpretation, we are able to estimate the reflection travel times of common reflection point (CRP) gathers from the migrated image and depth focusing panel. The estimated travel-times are then used to estimate velocity by a globally-optimized inversion algorithm. Not only do we succeed in avoiding the difficult work of picking prestack travel-times, but we also are able to use CRP gathers to handle multiple arrival events.

Interpretation of focusing panels is often complicated by the presence of spurious focus peaks. Based on the new analysis, we also develop a practical criterion which will help distinguish the true focusing from spurious focusing.

HGS Web Page Stuff

Contributed by Linda Sternbach

Please check the first article ever written just for the HGS web page.

It's called "WWWeb Tours for Geologists at Work and at Play", by Linda R. Sternbach with help from David Barthemy, Sam Leroy, Alan Jackson, et al. You can link directly from the page to the named sites. The last two tours of rock images, geologist's personal pages and fossil museum sites are the best!

If you check any of the sites out and have comments, email me at lsternbach@aol.com

GSH Auxiliary

Tuesday, May 13, 1997, Annual Business Luncheon at the Braeburn Country Club with Humorous Speaker Margaretta Bolding.

There is also a Duplicate Bridge Group that meets at 7:30 PM on the 2nd Friday of each month at the Bridge Studio, 6640 Harwin.

If you are interested in attending any or all of the auxiliary functions as a guest or would like to join our organization, contact Barbara Thigpen, GSH Liaison, at 281.497.3299. Cost is $5.00 for membership for the remainder of the year.

Texas Geoscientist Registration Effort

The following information was supplied to the HGS concerning the present status of geoscientist registration legislation in the State of Texas. HGS member Kerry Campbell at Fugro-McClelland is a principle contact for Houston. This update came on April 17th.

SB486 has passed the Texas Senate as of April 17th.

The bill will now go to the House where it probably will be assigned to the Licensing and Administrative Procedures Committee. The call will soon go out to geoscientists to do with the House committee and the full House what we just so successfully did with the Senate - that is, write letters asking for support.

The grassroots level support network of Texas geoscientists is the most valuable tool that has been used in this effort, thanks to the many dedicated geoscientists getting the word out. Two Senators, Drew Nixon and Jon Lindsay, changed their positions after voting against the Bill in the State Affairs Committee. Maybe some of the mail changed their minds.

The Baker Bill (HB744) was scheduled to be heard in the Licensing and Administrative Procedures Committee on April 21. THIS IS NOT THE BILL SUPPORTED BY THE TASK FORCE.

Please spread the word to contact all of the representatives who are members of the Licensing and Administrative Procedures Committee (see list on home page). Geoscientists need to ask them to call for House Bill (HB3447) to be brought up in committee, and for their support in reporting HB3447 (NOT HB744) out of committee with a favorable recommendation for passage on the House Floor. As always, this is an extreme rush, in that 744 is already scheduled to be heard in committee.

A full explanation of the Task Force and the registration effort in general can be found on the Task Force's home page at http://rampages.onramp.net/~wkc/texasgeo.html

Geophysics at the OTC

Visualization and High Performance Computing for Reservoir Characterization (May 5, 9:30 - 4:00)

In offshore exploration and production projects there is a trend toward larger data sets that cut across technical disciplines. The need to manage, integrate, and interpret data quickly, taking appropriate account of their multi-dimensionality, requires the use of advanced technology in computing and visualization methods. This session considers the application and benefits of state-of-the-art technology as it is currently practiced, with an eye toward future developments.

Marine 3-D Seismics (May 7, 9:30 -4:00)

New technologies for acquiring 3-D seismic data have begun maturing and surface streamer data no longer hold the exclusive position of years past. This session will examine vertical cable and ocean bottom cable systems, which offer alternatives to streamer data. New methods of acquiring streamer data are also examined including issues of sail line azimuths and bin spacing. In addition, new approaches to interpolation and survey design, which offer opportunities for reducing 3-D seismic costs without sacrificing quality, are highlighted. Finally, case studies of interpreting 3-D seismic surveys will examine the impact of seismic data on lithology estimation.

Time-Lapse Seismic Reservoir Monitoring (May 6, 9:30 - 4:00)

Time-lapse (4-D) seismic reservoir monitoring may represent a breakthrough in our ability to manage reservoirs efficiently and maximize their profitability. Changes in fluid saturation, pressure, and temperature that occur during production induce changes in the rock's density and compressibility that can be detected by seismic methods. As a result, repeated seismic data can be used to help monitor and predict the interwell position and movement of reservoir fluids, locate bypassed oil, avoid premature breakthrough, and optimize infill well locations. Presentations will discuss acquisition and processing issues related to repeat seismic data and describe the future of the technology, its practicality, and commercial viability.

Marine Seismic Acquisition (May 8, 9:30 AM - Noon)

New equipment and concepts are driving changes in offshore seismic acquisition. From marine shear-wave sources and high-resolution echo soundings on the source end through vertical cables and interferometric hydrophone technology on the receiver end, new technologies mean more options. This session will also showcase novel uses of existing technologies to obtain more useful images.

Subandean Basins Symposium

The 6th Simposio Bolivariano: Petroleum Exploration in the Subandean Basins, will take place in Cartagena de Indias, Columbia, on September 14-17, 1997. Organized by the Columbian Association of Petroleum Geologists and Geophysicists, the technical program will include case histories of the main oil and gas fields in the Subandean basins, as well as presentations on the petroleum systems of the Subandean basins, local and regional geology, and geological evolution of the Andean foldbelts. The symposium will also include field trips and a Technical Exhibition. For more information contact Roberto Leigh, A. A. 86648, Bogota, Columbia, fax 57-1-2148715 or 57-1-6820211, or in Houston contact Victor Vega, Amoco, phone 281-366-2802, or fax 281-366-3201.

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technology, resulting in development of the ENIAC (Electronic Numerical Integrator and Computer), which was used to compute ballistic missile trajectories.

In 1948, the invention of the transistor made it possible to start replacing large, inefficient vacuum tubes and building smaller, less costly computers. The first commercial computers using a central processing unit (CPU) became available about 1951. And by the mid-1950s, they began to find applications in the petroleum industry, initially in geophysical processing.

The Digital Age

In the 1950s, analog 2D seismic surveys were acquired, processed, and interpreted in the field by a person whose job title was literally "human computer." Using an early, integrated methodology, a single professional laid out the survey and supervised the shoot during the day. At night, he "processed" the shot records on paper, marking reflectors of interest and plotting them on rough cross sections and maps, looking for structural highs to recommend for drilling.

Then a group of mathematicians at MIT devised a way to convert analog seismic records into digital form using the latest mainframe computers. By 1956, digital seismic processing began to replace field processing by hand, dramatically improving the quality of seismic data. To do so, however, required a centralized computer facility, staff, and budget.

The Era of Centralized Computing (c. 1956-1981)

Throughout the 1960s and 1970s, the mainframe dominated business and technical computing. It was the era of batch data processing by huge machines that cost millions of dollars. But the invention of the integrated circuit in 1958 paved the way for the "downsizing" of hardware, which continues to this day. Texas Instruments is generally credited with inventing the integrated circuit. Interestingly, TI was a subsidiary of Geophysical Services Inc. at that time, and was responsible for developing seismic recording instruments for the petroleum industry.

Digital Equipment Corporation and Control Data were both founded in the late 1950s. IBM introduced the IBM 360 mainframe computer in 1960. By 1965, most large businesses routinely used mainframes to process financial information. Government-funded military and scientific research continued to produce new applications.

Mainframes in E&P. Corporate Management Information Systems (MIS) departments of large oil companies got big budgets to outfit and maintain centralized facilities. Most high-end computing resources in the petroleum industry during the next two decades were focused on two applications: geophysical processing and reservoir simulation. Both technical processes required intensive computational capabilities, due to the sheer volume of data. However, additional mainframe applications emerged during this period, including economic analysis, contour mapping, and petrophysics.

Mainframes could have hundreds of terminals attached to them simultaneously. Only the largest companies could afford to purchase the computers or develop the proprietary software they needed to operate efficiently. In the late 1960s, time-sharing arrangements opened the door for smaller companies to dial-in to a mainframe and access a set of commercial applications at a reasonable cost. But response times were significantly affected by the number of users and amount of data being processed.

Microprocessors. The next major breakthrough in information technology came in 1971 with the introduction of the general purpose integrated circuit by Intel. During the 1970s, microprocessors found their way into all types of oilfield equipment from downhole well logging tools to seismic acquisition technology, as well as consumer electronics such as video games, televisions, and automobiles.

Although well logging companies began recording and processing digital logs, they continued to deliver the results to customers on paper. To use well log data in the early mainframe petrophysical programs, users had to send selected curves to service companies for digitizing, a practice that continues today. Seismic processing centers also delivered final sections to interpreters on paper.

A Spectrum of Computers. Three other classes of computers evolved in the 1970s: at the high end, supercomputers and minicomputers; at the low end, the programmable hand-held calculator. For only a few hundred dollars, production and drilling engineers could rapidly perform reservoir and cash flow analyses with new electronic calculators. The slide rule died out by the early 70s.

Later in the 70s, supercomputers came into wider use in the oil business, primarily for compute-intensive reservoir simulations and seismic processing tasks such as migration. Otherwise, mainframes, dominated by IBM, still handled the bulk of the work. On the other hand, minicomputers such as the VAX from DEC began making cost-effective computing available to operating departments within E&P companies no longer under corporate MIS control.

Waves of the Future. Several other technologies that affect the industry today were born during this era of centralized computing. The first experimental 3D seismic survey, for example, was shot by Exxon in 1967, and by the mid-1970s 3D seismic had become commercial. In 1969, the U.S. Department of Defense created Arpanet, the first true computer network, to link military research contractors and universities. Arpanet was the ancestor of today's Internet.

Both Apple and Microsoft were founded in the mid-70s. Apple pioneered the concept of the personal computer. Microsoft began development of MS-DOS, the operating system that would dominate personal

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computing for the next decade. Oracle Corporation was also founded in the late 70s. In 1979, Oracle released the first relational database management system, an alternative to traditional hierarchical data management systems.

By the end of the 1970s, the hegemony of the corporate MIS group was eroding. Departmental computing on mini and super minicomputers was growing. And oil companies were enjoying the final years of the boom.

The Era of Personalized Computing (c. 1981-1990)

The year 1981 was a watershed, both for the petroleum industry and the information revolution. Oil prices began their precipitous drop from $34/barrel, pitching the industry into turmoil and almost endless restructuring. And IBM released the PC, instantly validating an emerging market.

Three years after the PC's introduction, Apple released the Macintosh. The Mac challenged IBM in the new marketplace, setting a whole new standard in graphical, user-friendly design with innovations such as the mouse, pull-down menus, icons, and "windows." The era of interactive, personal computing had begun.

Rapid Growth. Many of today's computer companies were founded in the early 1980s, including Silicon Graphics, Sun Microsystems, and Compaq. Computer applications for the workplace, school and home sprang up almost overnight. Many of the oil industry's leading software developers got their start about the same time. Landmark Graphics Corporation, for example, was founded in 1982, and delivered the industry's first commercial system for 3D seismic interpretation by 1984.

At that time, off-the-shelf hardware technology was insufficient to meet the needs of complex technical computing. So petroleum software developers built custom hardware platforms from the best available components. Even then, they were typically an order of magnitude smaller and cheaper than the minicomputers of the 70s. Eventually, standard workstations were developed by Sun, IBM, and others. Silicon Graphics created the first 3D computer graphic workstation in 1984.

Industry Changes. The money to pay for these new systems came from the operating budgets of E&P departments that were under increasing pressure to improve performance. Oil prices plummeted even further in 1986 and companies began laying off large numbers of professionals. To get their work done more efficiently, remaining users began to bypass the corporate computer bureaucracy. Personal computers made their way into oil companies without having to pass the scrutiny of MIS.

Early interactive workstations followed the same route, although they were still too expensive for individual use. Geophysicists signed up and waited in line to use departmental workstations on critical 3D seismic surveys. By 1980, only 100 3D surveys had been acquired worldwide. But that number jumped to over 1000 in the next decade, lowering both the risk and the cost of exploration and field development.

Technology Anarchy. Information technology in the 80s spanned a wide range of scales: supercomputers, mainframes, and superminis at the corporate level; minicomputers and workstations at the departmental level; PCs and programmable calculators at the personal level. It was an era of decentralized computing—some called it "anarchy"—characterized by a growing number of stand-alone systems. Despite obvious benefits to individuals and groups, the freedom created by these new systems began to impact the corporation's ability to share data and computing resources.

The E&P disciplines tended to divide along technological lines. Processing geophysicists and reservoir engineers continued to employ mainframes and supercomputers. Seismic interpreters moved onto interactive graphics workstations. Drilling and production engineers and well log analysts embraced PCs, carrying them from the office to the field. Geologists still worked mostly on paper.

Movement toward Standards. The high-end computers had proprietary operating systems (OS) that tended to lock customers into a particular brand. Since 1981, most PCs ran MS-DOS, making it easier for users to pick and choose. In 1985 Microsoft released its first version of Windows, a graphical extension to the DOS environment. Also during the mid-1980s, geoscience workstations began migrating to UNIX, an operating system first developed in 1969 by Bell Labs that ran on many different platforms. Universities could get UNIX almost free, and it soon became the OS of choice for technical computing applications in and out of the oil industry.

By the end of the 1980s, E&P organizations began looking for ways to integrate their diverse information technologies to create more synergy and lower costs. In 1989, the industry's first software integration framework was released, designed to provide multidisciplinary team members access to a common data management system. And local area networks sprang up in most large companies, ushering in the next era of petroleum computing.

The Era of Networked Computing (c. 1990 - Present)

About 1990, a new networked computing model pioneered in other industries first came into oil and gas companies, radically altering the way they would deploy technology in the final decade of the 20th century. Called client/server, the new model allowed companies to optimize their systems by distributing processes across a network. The big machines became "servers" for more intensive processing and mass data storage; the smaller workstations and PCs became "clients" for graphics display, applications, and limited data storage.

A significant difference between the client/server model and the terminal/

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mainframe model of the past was that every client system could interact with every other client on the network, rather than with the host computer only. As local area networks expanded to wide area networks and, eventually, global networks, communication via electronic mail quickly became commonplace. Today, networks are mission critical to oil companies of every size.

E&P Technology Proliferation. Development of new E&P software applications on UNIX workstations and PCs exploded during the early 90s. The larger oil companies continued to write proprietary software, but R&D budgets were down. Many companies began adopting commercial applications in greater numbers so they could concentrate more on their core competence: finding and managing oil and gas reserves.

Geologists, who still did most of their interpretations on paper, started using computers to interact with geophysicists in client/server workgroups. Petroleum engineers still used PCs mostly, often still in stand-alone mode. Efforts to coax them onto UNIX platforms to integrate their work with geoscientists typically failed. Companies began looking for technical bridges between the PC and UNIX.

New Operating Systems. Also during the 1990s, Microsoft Windows emerged as the PC industry standard, with millions of users worldwide and prolific software development. In 1993, Microsoft released Windows NT, a next generation network operating system that many observers believe could eventually displace UNIX in the technical arena. The gap between workstations and PCs remains, but seems to be narrowing with time.

Data Explosion. The oil industry also underwent a data explosion comparable to the information technology revolution. 3D seismic technology spread wildly, even among very small exploration companies from 1992 onward. Geophysical analysis, once confined to exploration and early field development, expanded into production and reservoir management. Major oil companies began experimenting with early 4D, or time-lapse, seismic reservoir monitoring. Demand for smaller, faster, and more powerful computers grew. 3D graphic visualization systems moved out of the research centers into the mainstream user community.

Seismic processing and reservoir simulation, which had long driven high-end computing in the oil patch, turned to new parallel processing techniques. Parallel processing utilized multiple CPUs to deliver supercomputing power to desktop workstations in the E&P office. Geoscientists and engineers were able to process larger volumes of data at record speeds. Reservoir simulation, once relegated to research projects in very large fields, gained momentum in more routine operations.

The need for larger, more efficient database systems grew as well during this time. Relational database management systems became the preferred way of managing digital data in the larger petroleum companies.

E&P Industry Standards. Proliferation of disparate technologies in exploration and production led to formation of two industry standards organizations in 1990—the Petrotechnical Open Software Corporation (POSC), and the Public Petroleum Data Model (PPDM) Association. The mission of both groups was similar: to develop computing standards that would facilitate integration of processes across the upstream oil and gas business. Both organizations have attracted widespread support and membership from oil companies, computer vendors and software suppliers. Work is currently underway to unify the two efforts, to create a single relational data standard for E&P.

The Global Network. Meanwhile, the Internet—the world's largest client/server network—has become the most revolutionary new force in the oil patch, challenging time-honored ways of working and opening up new opportunities for growth. Within the past two years, huge numbers of oil companies, service providers, computer vendors and software developers have gone online on the World Wide Web.

Internal Web-based networks, called "intranets," are rapidly becoming the preferred communication vehicle for many corporations, including oil companies. And "virtual" E&P organizations are becoming a reality as the digital age of petroleum technology approaches the end of its fifth decade.

Conclusion

Since its origins nearly 150 years ago, the petroleum industry has undergone repeated periods of self-renewal, often due to the introduction of new technology. Today, oil companies are becoming knowledge- rather than asset-based businesses. Information technology is unifying long-segregated technical and business processes, enabling companies large and small to streamline costs, increase profits, and compete more effectively in the global marketplace.

"Integration" is the watchword. Oilfield service companies are integrating all aspects of field operations using computer technology. The E&P office is moving toward common data standards and fully integrated multidisciplinary asset teams. Advanced telecommunications systems are linking the oilfield with the office, worldwide. And new data management systems promise to integrate business and financial data with reservoir and field data, to improve overall E&P decision-making processes.

Despite the complexities and uncertainties, technology continues to revolutionize petroleum exploration and production. Surprises abound. Rapid change is the norm. Oil companies that want to compete in the 21st century must learn how to identify information technologies with high strategic value, and adopt them as efficiently as possible.

GEOPHYSICAL SOCIETY OF HOUSTON

12 th ANNUAL SPORTING CLAYS TOURNAMENT

Saturday
September 6,
1997

The 12th Annual Shooting Clays Tournament will be held on September 6 at the American Shooting Centers. Come on out and try the passing dove and springing teal, goose tower and other challenging shots. The tournament will be an all day event and family participation is encouraged.

The tournament will be a 50 bird event and participants will shoot in groups of five (5). Participation is limited to 200 shooters, and due to the Labor Day Weekend, the sign-up deadline will be extended to September 3. Shells, BBQ lunch and refreshments will be provided.

To enter, complete the form below and mail along with a check payable to:

Western Geophysical
P.O. Box 2469
Houston, Texas 77252-2469
Attn.: Chris Tutt
(713) 963-2648 Fax: (713) 963-1921

GEOPHYSICAL SOCIETY OF HOUSTON
11th ANNUAL SPORTING CLAYS TOURNAMENT
SEPTEMBER 6, 1997

NAME: ______________________ **TEL: (RES)** ______________ **(WRK)** ______________

ADDRESS: __________________________ **COMPANY:** ______________________

PREFERRED SHOOTING TIME: (circle one) 8:00 9:45 11:00
— Please arrive 30 minutes before shooting time —

SHOOTING GROUP (including self)

1. ______________________ **12/20**

2. ______________________ **12/20**

3. ______________________ **12/20**

4. ______________________ **12/20**

5. ______________________ **12/20**

(CIRCLE GUN TYPE)

GSH/HGS Members or Guest $55.00

DISCLAIMER:

I acknowledge that neither the Geophysical Society of Houston nor the American Shooting Centers will be held responsible for injury or accidents during this event. *PRACTICE SAFETY!!*

NAME: ______________________ **GUEST:** ______________________

ANNUAL HONORS AND AWARDS BANQUET

Thursday, May 8, 1997

Lakeside Country Club

6:30 p.m. - Cash Bar
7:15 p.m. - Dinner

Music by Marshall Maxwell

GSH Life Members

Lee C. Lawyer • Merry Lynn Southers

GSH Honorary Members

Stuart W. Fagin • Robert W. Mitchum, Jr.

SEG 50 Year Honorees

Nelson C. Steenland • Robert M. Tesar • Robert J. Bean
W. A. Knox • Stanley M. Leventhal • Henry G. McCleary
Robert M. Tesar • James M. Watson

SEG 25 Year Honorees

Robert Lewis Ayers
Ian Atkinson
Roger G. Baker
M. Lee Bell
Alan Berger
Martin Louis Bregman
James Weldon Buelow
John Gavin Butler
Gregory M. Cleveland
Benjamin F. Collins
Charles T. Contrino
Joel Robert Davis
Kenneth N. Dunlap
Robert C. Edmiston
Radwan Ahmed Elsayed
Elmer Eisner
Gregory E. Evans
Kenneth R. Evans
Tom Richard Evans
Steven Lawrence Getz
Hugh F. Grover
Emile Guerin
Thomas Hamilton
Donald R. Heider
Donald P. Heitzman
Edward Vernon Herbert
Christian J. Herrmann
George J. Jungels
Ghing-nan Kao
Surrindor Kapoor
Lee Lu
Alexander G. MacKeon
James Robert McCreight
Federico David Martin
Cecil Lee Meigs
Danny Rayburn Melton
Robert Alan Miller
Geoffrey F. Mills
Nancy Rose Money
Scott Edward Moravec
Ashoke Kumar Nath
Emil A. Nakfoor
Bruce H. Nelson
Raymond L. Noel
William G. North
James R. Orgill
Michael H. Paine
Joe Dan Parker
John Richard Porter
Patrick L. Prout
Karl Schneidau
Youngsun Shin
Bobbye L. Silva
Lewis A. Van Coutren
Thomas R. Wittick
Frederick Joseph Wells
Neil S. Zimmerman

GSH Honorees

Lee C. Lawyer
GSH Life Member

L. C. (Lee) Lawyer has been very active in the SEG. He was General Chairman of the SEG Convention in San Francisco in 1978, SEG 2nd Vice-President in 1987-88, President-Elect in 1986-87 and President in 1987-88. He subsequently served on the SEG Advisory Committee, and currently is the Treasurer of the SEG Foundation, Chairman of the GSH Advisory Committee, and SEG Section Representative from the GSH. He writes, "From the Other Side" in The Leading Edge. He retired from the Chevron Corporation in 1992. A 1955 graduate of Oklahoma University, he joined Standard Oil Company of Texas, forerunner of Chevron, as a client representative on a company seismic crew. He was Division Geophysicist for Chevron's Mid-continent and Alaskan Divisions, Chief Geophysicist of Chevron Overseas and vice-President of Chevron Geosciences. When he retired, he was the Chevron Corporation Chief Geophysicist. B.J. and Lee have two children, Mark and Mitchell, and four grandchildren.

Merry Lynn Southers
GSH Life Member

Ms. Southers began her geophysical career in seismic data processing at Seiscom Delta in 1971 after receiving a BS in math from the University of Houston in 1969. Her managerial and technical skills propelled her to the position of Data Processing Manager by 1979. Simultaneously, she earned an MBA from Pepperdine University. Merry Lynn went on to managerial positions at SeisPros and Business Archives, a division of Petroleum Information/Dwights. She currently serves as the General Manager of Business Archives.

Her enthusiastic leadership and professionalism have merited her much respect and admiration. Merry Lynn has been a member of the GSH since 1972. Her service over the last 16 years includes Editor of the Newsletter, Secretary, GSH Membership Chairman, Second Vice President, SEG Section Representative (several times) and Chair of the Honors and Awards Banquet for four consecutive years.

Robert M. Mitchum
Honorary Member

Although retired from Exxon, Bob Mitchum remains very active in teaching seismic sequence stratigraphic workshops and consulting. He also has explored in the Texas and Louisiana Gulf Coast with Robert M. Sneider. His primary interest is in the application of sequence stratigraphy and seismic stratigraphy to hydrocarbon exploration on a worldwide basis.

He retired in 1988 as Senior Research Advisor from Exxon Production Research Company after 34 years experience. He was one of the principal members of the Exxon team that developed concepts of seismic stratigraphy and sequence stratigraphy. He has authored many papers on sequence stratigraphy and continues to publish in this area. At Exxon he specialized in practical applications of this technology in regional seismic exploration projects for Exxon affiliates around the world and in training explorationists in this field. He has worked in the US Gulf Coast, West Texas, Paradox Basin, offshore Alaska, Beafort Sea, Western Canada Basin, North Sea, Norway, Libya, Morocco, Ivory Coast, Chad, Niger, Gabon, Angola, Brazil, Argentina, Chile, Australia, China and other countries. Before his, he specialized in carbonate facies research and was a principal organizer of Exxon carbonate facies schools.

In addition to his sequence stratigraphy publications, Mitchum has published several key papers on deep sea fans and turbidites and their seismic recognition.

Mitchum is a member of the American Association of Petroleum Geologists. He was a co-recipient of the Presidents award with P.R. Vail and J.B. Sangree for papers on seismic stratigraphy in the 1977 AAPG Memoir 26. He also received the Robert H. Dott Sr. Award with J.C. Van Wagoner and other co-authors for the AAPG special publication methods in exploration number 7 in 1992. He is a member of the Society of Economic Geophysicists, the Society of Economic Paleontologists and Mineralogists and the Houston Geological Society.

Bob was born in Nashville, Tennessee in 1928. He gained his BA and MS at Vanderbilt in 1950 and 1951, then went on to Northwestern where he gained his Ph.D. in geology in 1954, working with Dr. L.L.Sloss.

Dr. Stu Fagin
Honorary Member

Dr. Fagin has worked for Paradigm Geophysical Corporation, a depth imaging software and services company, since 1993. Through most of this time, Stu has had the role of VP of Technology for the Houston office. In this role Stu has facilitated the transfer of model-based depth imaging technology to the petroleum industry through the presentation of workshops, lectures and technical articles. Recently he has changed appointments to work for the headquarters office in Tel Aviv, where his role is Product Manager of Earth Model, Paradigm's new product devoted to map-based time depth conversion. In this role Stu is charged with guiding the design, development and presentation of the product to the industry.

Dr. Fagin has 12 years of experience with Exxon, primarily with Exxon Production Research Company, where he worked with the seismic stratigraphy and structural interpretation groups. His research with Exxon Production Research included the investigation into the use of seismic modeling as an aid to structural interpretation and imaging. It was this work that served as the basis of the SEG volume, "Seismic Modeling of Geologic Structures". With the structural

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interpretation groups Stu performed research in structural balancing in extensional environments and published papers related to this from the Irish Sea. His last research was in 3D seismic interpretation where he demonstrated the use of attribute analysis for the definition of small-scale faults.

Stu also spent time with Exxon Exploration Company exploring in the Irish Sea from their London office, and the deep water Gulf of Mexico, from their Houston office.

Stu received his Ph.D. in geology from the University of Texas in 1983. His dissertation was the paleotectonics of the Eastern Klamath Mountains. He was a structural geologist who wandered into geophysics classes. To this day he places total blame on Milo Backus for inciting an interest in geophysics. Stu grew up in Brooklyn and was attracted to geology because of the opportunities it afforded to take him out of the city. He obtained a BS in geology from Brooklyn College in 1973, while driving a NYC taxi cab to keep him in food and rent. After brief stints as an engineering geologist, a NYC public school science teacher (very brief), and the Environmental Protection Agency, Stu obtained an MS in geology from George Washington University in 1977.

Stu's wife Alice is a former geologist with the Bureau of Economic Geology and Sohio. She is retired since 1986 and spends her time raising their two sons Joel and Ira. Joel, 15, is a high school freshman, while Ira, 11 is in 6th grade. The Fagin's live in Kingwood, an occupied territory of Greater Houston. They like most sports activities and have gone through phases of soccer, baseball, and basketball, with Stu doing a lot of coaching. Their current interest is tennis. Stu and Alice favor outdoor vacations which offer them the opportunity to bore Joel and Ira with their geologic background.

GSH March Technical Luncheon

Deonel Fuselien, Geco-Prakla • Lynn Trembly, Pennzoil • Ron Koehler, Shell

Stephen Bircher, Hampsen Russell • Shawn Porche, Expro.

GSH Auxiliary February Bridge Luncheon

Left to Right: Linda Robeson, Bob Ann Rossi, Dorothy Wright, Jerry Templeton

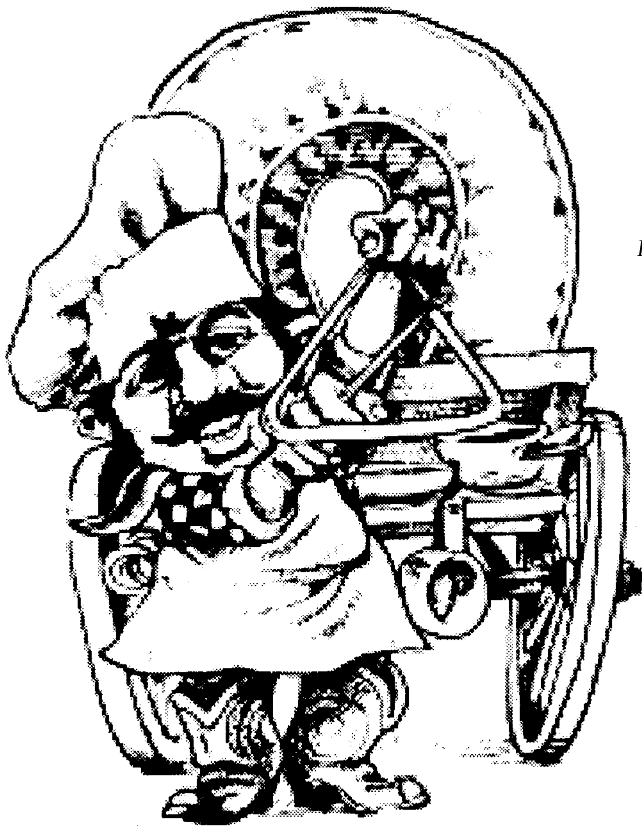
ANNUAL MEETING

and

Bar-B-Que

RAIN or SHINE

5:00 p.m. to 8:00 p.m. on Thursday, May 15, 1997
at the Knights of Columbus Hall, 607 East Whitney



Come Enjoy A Great Evening
Welcome The New GSH Officers

Tickets:

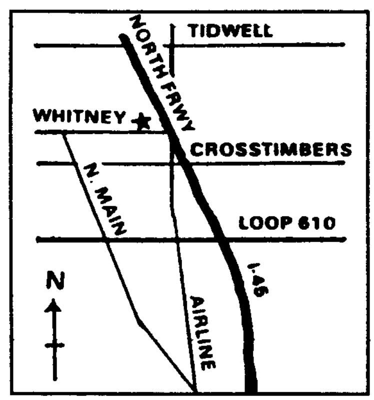
Only $12.00 Each
If Purchased By May 13, 1997
$17.00 Each At The Door

Note:

We Have To Guarantee The Number Of Dinners, So You Must Prepay To Be Guaranteed Your Meal.

WE WILL BE SERVING

- Bar-B-Que Brisket
- Sausage
- Chicken
- Beans
- Cole Slaw
- Bread
- Pickles
- Onions
- Draft Beer
- Wine
- Soft Drinks
- Iced Tea



Annual Meeting and Bar-B-Que

Thursday, May 15, 1997 Knights of Columbus Hall

Name: ______________________________ *Phone:* ______________

Name: ______________________________ *Phone:* ______________

Number Tickets Desired: ______________ *X $12.00 Each = $* ______________

Enclose Check Payable To: Geophysical Society of Houston

And Mail To: Jim Moulden, c/o Legacy Solutions
7880 San Felipe, Suite 200
Houston, Texas 77063
(713) 975-9810

Tickets Will Be Held At The Door. If Your Company Is Purchasing A Block Of Tickets - Please Indicate Names On The Form To Eliminate Any Confusion At The Door.

Ticket Orders Must Be Received By May 13, 1997 to Obtain $12.00 Price.

NORTH HARRIS COLLEGE
GEOSCIENCE TECHNOLOGY TRAINING CENTER

SUMMER 1997 COURSE SCHEDULE

For information concerning REGISTRATION, FEES, COURSE DATES/ TIMES, LOCATION and GENERAL COURSE INFORMATION contact: (713) 443-5600 - phone (713) 443-5633 - fax

MAY

AN INTRODUCTION TO UNIX-BASED SYSTEMS ADMINISTRATION 24 hours.

This introductory course will discuss UNIX-based workstation systems administration from the viewpoint of the systems administrator. System maintenance, data base administration and storage, backup and restoration procedures, networking, space allocation, and security are some of the topics to be addressed by this course.

CGTTC 2D012 NNHO1 T 5/20 - 6/24 6:00 pm - 10:00 pm WN 261

JUNE

WORKSTATION-BASED GEOGRAPHICAL INFORMATION SYSTEMS 24 hours

This course discusses cartographic techniques and explores the use of GIS on a personal computer. It will cover the basics of what GIS is and what it can accomplish. GIS has technological applications in the petroleum industry, environmental sciences, city and utility planning, and for sales and marketing analysis.

CGTTC 2C011 NNH01 M/W 6/2 - 6/18 6:00 pm - 10:00 pm CE 207

WORKSTATION INTERPRETATION - Z-MAP PLUS 24 hours

This course will utilize ZYCOR software to explore the mapping of geophysical and geological data on a computer workstation. It will cover mapping coordinate systems, projection types, importing of data files, gridding, Base map generation, contouring, editing and display techniques.

CGTTC 2E061 NNH01 Sa 6/14 - 6/28 8:00 a.m. - 5:00 p.m. WN 261

COMPUTER WORKSTATION MODELING - AVO 24 hours

This course deals with the analysis of Amplitude Variations with Offset (AVO) and post-stack amplitude inversion. Topics will include seismic data processing and displays, forward modeling using well log data, synthetic models, and model-based inversion methods utilizing well logs and NMO velocities, and seismic trace attribute extraction.

CGTTC 2B011 NNH01 T/W/Th 6/17 - 6/19 8:00 a..m. - 5:00 p.m. WN 261

WORKSTATION-BASED GEOGRAPHICAL INFORMATION SYSTEMS II 24 hours

This course teaches students the basic ARC/INFO commands which create, edit, and produce geographic data. Topics include using logical queries to create new data, changing existing data, producing maps, linking geographic data to external spreadsheets. Prerequisite: knowledge of basic mapping techniques or instructor approval.

CGTTC 2C012 NNH01 M/W 6/23 - 7/9 6:00 p.m. - 10:00 p.m. WN 261

WORKSTATION INTERPRETATION: SEISMIC MICRO TECHNOLOGY 24 hours

Students will utilize 2d/3dPAK seismic interpretation software to interpret a seismic data set on PC's. Students will interpret faults, horizons, create time slices, polygons, create various vertical seismic displays, and manipulate colors using a variety of workstation viewing options and utility functions.

CGTTC 2E071 NNH01 M/W 6/23 - 7/9 6:00 - 10:00 p.m. CE 207

WORKSTATION INTERPRETATION - GEOQUEST **24 hours**
Students will utilize a UNIX workstation, GEOQUEST IEX-IESX and 3D seismic data to interpret faults and horizons, create time slices, and contour maps using a variety of workstation viewing options and utility functions.

GTTC 2E031 NNH01 T/W/Th 6/24 - 6/26 8:00 a.m. - 5:00 p.m. WN 261

JULY

WORKSTATION INTERPRETATION - SEISWORKS **24 hours**
Students will utilize a UNIX workstation, LANDMARK SeisWorks and 3D seismic data to interpret faults and horizons, create time slices, and contour maps using a variety of workstation viewing options and utility functions.

CGTTC 2E051 NNH01 T/W/TH 7/8 - 7/10 8:00 a.m. - 5:00 p.m. WN 261

AN INTRODUCTION TO ORACLE **24 hours**
This class is designed to introduce students to the ORACLE database administrator, and is the first in a series of three ORACLE courses. Topics will include client/server computing, networking and related issues, SQL, and PL/SQL.

CGTTC 2F011 NNH01 M/W 7/14 - 8/6 7:00 p.m. - 10:00 p.m. CE 207

WORKSTATION INTERPRETATION - PHOTON **24 hours**
Students will utilize a UNIX workstation, PHOTON Software and 3D seismic data to interpret faults and horizons, create time horizons, and contour maps using a variety of workstation viewing options and utility functions.

CGTTC 2E041 NNH01 T/W/Th 7/15 - 7/17 8:00 a.m. - 5:00 p.m. WN 261

GIS: E R MAPPER **24 hours**
ERMapper is a powerful package for processing satellite images, photographs, and seismic horizons into finished maps. The course will teach baasic commands to process several kinds of information including land and geophysical information. both rasters and vectors will be used in final displays, as well as converting between them. Geolinking is used in tuerning images into properly projected maps.

GTTC 2C051 NNH01 M/W 7/21-8/6 6 p.m. - 10:00 p.m. WN 261

WORKSTATION INTERPRETATION - GEOQUEST **24 hours**
Students will utilize a UNIX workstation, GEOQUEST IEX-IESX and 3D seismic data to interpret faults and horizons, create time slices, and contour maps using a variety of workstation viewing options and utility functions.

GTTC 2E031 NNH02 T/W/Th 7/29 - 7/31 8:00 a.m. - 5:00 p.m. WN 261

CGTTC 2E051 NNH02 T/W/TH 8/12 - 8/14 8:00 a.m. - 5:00 p.m. WN 261

For information concerning course content or instructional software please contact:

Sarah G. Stanley, Coordinator
Geoscience Technology Training Center
North Harris College
2700 W. W. Thorne Drive
Houston, Texas 77073-3499
Telephone: 713-443-5715

Submittals and suggestions should be sent to the GSH Editor at 7457 Harwin, Suite 301, Houston, TX 77036, or call Cliff Kelley, Editor, at 368-8103, or Fax to 368-8182. Deadline for submission is the 1st of the month preceding publication: e.g., September 1 for the October issue. Digital or electronic submittals required.

MAY 1997

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
				1	**2**	**3**
4	**5** **Offshore Technology Conference**	**6** **Offshore Technology Conference**	**7** **Offshore Technology Conference**	**8** **Interactive Workstation SIG** Schlumberger Geco-Prakla **GSH Honors & Awards Banquet** **Offshore Technology Conference**	**9**	**10**
11	**12**	**13** **GSH Technical Breakfast** Mobil's Greenspoint Location **GSH Auxiliary Annual Business Meeting** Braeburn Counrty Club	**14**	**15** **GSH Annual Meeting & Bar-B-Que**	**16**	**17**
18	**19**	**20**	**21** **Data Processing SIG** Exxon Production Research Company	**22** **GSH Potential Fields SIG** HESS	**23**	**24**
25	**26**	**27**	**28**	**29**	**30**	**31**

GEOPHYSICAL SOCIETY OF HOUSTON

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