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NEWSLETTER

DECEMBER 1996

Outlook '97

Will integration go mainstream in 1997?

Traveling around the world this year, I've noted that 3D seismic use is heating up in places such as Asia and Latin America. For example, during an Indonesian petroleum convention in October, where I presented Landmark's vision of enterprise-wide integration, I spoke with a number of our customers in the region. Almost every one of them said they are significantly increasing 3D acquisition. Some, in fact, are concerned that the service sector may

actually become capacity bound, that there may not be enough ships and crews to handle the growth.

I honestly don't know if that's true. But I do know that once companies adopt 3D seismic technology, their interest in computerizing — and integrating — related technical processes usually follows. First they get 3D seismic interpretation and visualization systems. Then they bring in geological and petrophysical tools to help build more comprehensive subsurface models. At some point, depending on where they are in the oil field life cycle, they want to integrate reservoir engineering as well. That, at least, is a pattern I've seen over and over, in large and small companies alike.

far-flung regional divisions of multinational oil companies, we find ourselves dealing with corporate management. We often collaborate with both regional and corporate offices to create a global I.T. strategy. To a certain extent, the need for integration is driving that.

Once they start examining work processes across the disciplines, many companies realize they must forge new relationships with technology and service providers like Landmark. They find it more efficient and cost-effective to align with a single large supplier that can create integrated environments and link third party applications, rather than dealing with many vendors and doing the integration themselves.

During 1996, for example, Landmark entered into several long-term strategic alliances with oil companies in Europe and North America. In each case, we're supplying much more than software. We're also providing professional consulting, data management, customized training, and onsite support services. I expect this trend toward integrated solutions to continue throughout the coming year.

Ten years ago, the early adopters were just discovering 3D seismic. Now 3D is a mainstream technology for geophysicists, and the industry is discovering the business advantages of integrated technology for whole teams. I expect integration to go mainstream soon. And my hunch is that 1997 may be the turning point.

Bob Peebler, President & CEO
Landmark Graphics Corporation

So I expect global expansion of 3D seismic during 1997 to have a ripple effect throughout Landmark's business, not just in our processing and interpretation product lines.

Not only are technical professionals in multidisciplinary teams getting more serious about information technology, but more executives are realizing that I.T. is strategic to overall business success. And integrating all of the work processes involved in finding and managing oil and gas reserves is critical to the bottom line. Executives know they can't delegate all of the I.T. decisions any more. That's why Landmark has been spending more time this past year with senior level decision makers in oil companies, as well as mid-level managers and users.

We're helping E&P organizations sort out their I.T. needs on a much broader scale than ever before. Even in

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GEOPHYSICAL SOCIETY OF HOUSTON

Margaret Blake, Office Manager • 7457 Harwin Drive, Suite 301 • Houston, Texas 77036
(713) 785-6403 • Fax (713) 785-0553 • Office Hours 7 a.m. - 4 p.m.
Event Reservations Number: (713) 917-0218

GSH Board of Directors = GSH Executive Committee + SEG Section Representatives

PRESIDENT	Wulf Massell	650-3820	fax 659-3735	geowulf@aol.com
Corporate Relations	Arthur Ross	423-5476	fax 464-1615	Art.H.Ross@exxon.sprint.com
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Honors & Awards	Art Ross	423-5476	fax 423-5202	
Museum	Ray Farrell	552-1453		
Nominating	Wulf Massell	650-3820	fax 650-3822	geowulf@aol.com
Tellers	Lorinda Driskill	560-1104	fax 666-9439	lorindad@aol.com
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Academic Liaison	Dale Sawyer	285-5106	fax 285-5214	dale@rice.edu
Advisory	Lee Lawyer	531-5347	fax 531-5347	ujhr40a@prodigy.com
Employment Referral	Sam LeRoy	556-9766	fax 556-9778	earthview@aol.com
Finance	David Forel	963-2493	fax 963-2490	david.forel@waii.com
Office	David Forel	963-2493	fax 963-2490	david.forel@waii.com
Volunteers	Bill Gafford	366-7873	fax 366-7569	wtgafford@amoco.com
FIRST VP	Dave Agarwal	650-0325	fax 650-3822	
Continuing Ed.	Dan Ebrom	743-9144	fax 743-9164	ebrom@uh.edu
Speakers	Dave Agarwal	650-0325	fax 650-3822	
Tech Breakfasts	Scott Sechrist	956-8029	fax 856-7445	acoustic@neosoft.com
Tech Luncheons	Phil Hoseman	655-9838	fax 655-7301	
Technical Committee	Pat Starich	423-7234	fax 423-7917	76020.2244@compuserve.com
Technical Transfer	David Forel	963-2493	fax 963-2490	david.forel@waii.com
SIGs:				
Data Processing	Young Kim	966-6156	fax 966-6333	
Environmental Appl.	Stephanie Hrabar	683-0638	fax 683-0638	
Interpretation WS	Larry Godfrey	750-7544	fax 750-7584	
Potential Fields	Chuck Campbell	993-0671	fax 960-1157	
Reservoir Geophysics	Tien-When Lo	954-6249	fax 954-6113	
SEC. VP	Lloyd Weathers	775-2453	fax 775-4123	Lloyd_r_weathers@ccmepus.mobil.com
Annual Meeting	Jim Moulden	659-2201	fax 659-2301	
Awards Banquet	Carmen Comis	876-3473	fax 876-1359	
Golf Tournament	George Lauhoff	630-4011	fax 630-4311	
Shrimp Peel	Tim Hartnett	961-8500	fax 961-8400	
Sporting Clays	Robert Perez	240-1234	fax 240-4997	
Christmas Party	Lorinda Driskill	560-1104	fax 560-1169	ldriskill@lgc.com
Tennis Tournament	Joe Jones	438-5626	fax 682-6928	
SECRETARY	Lorinda Driskill	560-1104	fax 666-9439	ldriskill@lgc.com
Directory	David Forel	963-2493	fax 963-2490	david.forel@waii.com
GSH Membership	Steve Starr	498-7008	fax 498-0913	
Ladies Auxiliary	Barbara Thigpen	497-3299		
OTC Representative	Alf Klaveness	468-5123	fax 468-0900	
SEG Membership	Jill Floto	974-0822	fax 974-1928	
TREASURER	Joel Starr	781-4000	fax 781-7858	joel@hstn.tensor.pgs.com
Student Loans	Don Ashabranner	669-3782	fax 669-3725	
EDITOR	Cliff Kelley	368-8103	fax 368-8182	kelley@houston.geoquest.slb.com
Assistant Editor	Dennis McMullin	560-1069	fax 560-1278	dmcmullin@lgc.com
Company Contacts	Scott Sechrist	464-8200	fax 856-7445	acoustic@neosoft.com
Electronic Pub.	Victor Koosh	773-2627	fax 773-9620	vkoosh@NewWorldHorizon.Com
Photography	John Freeland	423-7223	fax 423-7801	
Publicity	Scott Sechrist	464-8200	fax 856-7445	acoustic@neosoft.com
Training Notices	Lloyd Weathers	775-2453	fax 775-4123	Lloyd_r_weathers@ccmepus.mobil.com
PAST PRESIDENT	Art Ross	423-5476	fax 423-5202	Art.H.Ross@exxon.sprint.com
PRIOR PAST PRES	TomFulton	464-1300	fax 464-1615	
SEG SECTION REPS				
.....	Lee Lawyer	531-5347	ujhr40a@prodigy.com	
.....	Richard Verm	782-1234	fax 782-1829	richard@geodev.com
.....	Pamela Moore	773-2627	fax 773-9620	pmoore@NewWorldHorizon.Com
.....	Bob Tatham	954-6027	fax 954-6113	TATHARH@texaco.com
Alternate SEG Sec. Reps.				
.....	Pat Peck	963-7801	fax 963-7890	
.....	Merry Lynn Southers ..	840-8282	fax 599-9110	
.....	Hugh Hardy	729-9208	fax 726-0456	
.....	Cheryl Stevens	stevens@pakhome.khi.erum.com.pk		

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Editors Note

I hope you enjoy the collection of thoughts on 1997 and beyond, that we gathered for the newsletter. I believe, they well represent a sampling of the Houston area geophysical community. They are sometimes personal and sometimes corporate viewpoints, but that is what I asked for. I wish to thank all of the contributors for their time, energy and courage to discuss the future in black and white.

I also hope everyone has a joyous holiday season. This year has been a challenging year for me personally on several levels: editorship, a new job and battling cancer. All things considered it has been a great year. I am looking forward to an outstanding 1997, both personally and professionally.

Remember, I want to hear from you. Call me, Fax me, E-mail mail. This is our society and newsletter, your participation will make it better for all of us. The topic next month is Depth Imaging.

Happy Holidays

Cliff Kelley
Schlumberger Wireline
1325 South Dairy Ashford
Houston, Texas 77077
713/368-8103 Phone
713/368/8182 Fax
kelley@houston.geoquest.slb.com
E-mail

Technical Breakfast

Date: Tuesday,
December 10, 1996
Time: 7:00 - 8:45 a.m.
Location: Amoco, at 501 Westlake
Park Blvd, South of I-10,
between Highway 6 and
Eldridge. Follow signs for
visitor parking, and check
with the receptionist for the
meeting room location.
Topic: The Use of 3D Seismic
Data for Geohazards
Assessment in the Gulf of
Mexico
Speaker: Bill Gafford, Amoco

3D seismic data, acquired for oil and gas exploration purposes, is now being used to supplement, or in some cases, even replace conventional high resolution geohazard surveys in the Gulf of Mexico. The use of 3D seismic data has improved the identification and understanding of some types of geohazards and has resulted in a more thorough interpretation of the shallow geologic section. The use of seismic interpretation workstations has allowed the geohazard interpreter to apply new tools in geohazard analysis. Some of the newer geophysical technologies used for exploration purposes are now being adapted for use in the identification and assessment of drilling hazards in the near seafloor sedimentary section.

Examples are shown where exploration 3D seismic data has been used to supplement or replace conventional geohazard data. Some of the advantages as well as the disadvantages and limitations of the 3D data are discussed. The goal is a more complete analysis and understanding of the shallow sedimentary section, particularly as it relates to potential drilling problems.

Environmental Applications SIG

Affiliated with the Near-Surface Geophysics Section of the Society of Exploration Geophysicists and the Environmental/Engineering Committee of the Houston Geological Society

Date: Thursday,
December 5, 1996
Time: 4:00-6:00 p.m.
Host
Company: Texaco (Phil Inderwiesen)
Location: 3901 Briarpark (Corner
of Westpark and
Briarpark; 1 -stop light
east of Beltway 8).
Visitor parking no
charge. Check in with
receptionist and you will
be directed to the meeting
room.
Cost: None. Open to the
public.

Program

Coordinator: Stephanie Hrabar, PG
(KY), CFE, CPO phone
713/683-0638.

Forum: Environmental Problems
-What Are They?

- John Duffield and Karl Looff, SOFREGAZ, North Dayton Salt Dome-the obverse view. This geoscience team will describe some unanticipated implications of technical work that sometimes conflict with the prevailing regulatory view, which changed during the life of a hazardous waste disposal project. (40 minutes)

- HC Clark, Warren Franz, Alf Klaveness, and Stephanie Hrabar French Limited Superfund Site-non-intrusive geophysical/ data acquisition during the remediation phase at a hazardous waste disposal site This team will describe non technical problems associated with data acquisition. (20 minutes). Safety Message: Temperature, poisonous plants, and water.

Format: Exhibits and posters will be posted and may be reviewed before and after the informal session. Presentations are followed a dialogue with the audience. Session ends promptly at 6:00 pm.

NEXT MEETING: Thursday,
January 23, 1997

Reservoir Geophysics SIG

The Reservoir Geophysics Special Interest Group is an interdisciplinary forum for the discussion of reservoir geophysics topics of interest to geophysicists and geologists, and expanded interchange with the reservoir engineering community.

Date: Tuesday,
December 10, 1996
Time: 4:00 p.m.
Place: Texaco EPTD
3901 Briarpark (Corner of
Briarpark and Westpark)
Conference Room A

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Cost: No charge
Topic: An Event Specific Seismic AVO Method
Speaker: Thomas Hu, Texaco EPTD
Organizer: Tien-when Lo, RC Squared Consulting

An Event Specific Seismic AVO Method
Thomas Hu, Texaco EPTD

Seismic amplitude versus offset (AVO) detects potential hydrocarbon accumulations by examining prestack reflection amplitude at different source-to-receiver offsets. The trend of AVO variations at different surface locations serves as a direct indicator to changes of rock properties and/or subsurface fluid content. This information can be used as one of the tools to help geophysicists identify anomalies in building prospects and delineating reservoir boundaries.

Whereas similar amplitude versus offset analysis methods exist in the industry, the method discussed herein, XAVO, is more robust and flexible. It analyzes AVO effects specific to interpreted horizons. These even specific target amplitudes are normalized by amplitudes extracted from another reference horizon. The normalization process helps minimize amplitude variations caused by changes in the overburden and makes a "true" amplitude recovery preprocessing less critical. This method has been proven successful in many parts of the world.

The method has been implemented on a workstation, migrated from a program originally running on a mainframe. The client/server XWindows environment enables users to interactively scrutinize data quality, edit out noisy picks, and visualize results in multiple windows simultaneously. The add-in automatic analysis modules, easy-to-control graphical user interface and event-driven processes greatly increase user efficiency.

Seismic Processing SIG

Date: Wednesday, December 11, 1996
Time: 4:00 - 6:00 p.m.
Location: Amoco Production Co., 501 Westlake Park Blvd., Terrace Room (First Floor, Westlake 1 Bldg.)
Cost: NO CHARGE, please call 917-0218 for a reservation
Topic: Anisotropy and AVO
Speakers: Leon Thomsen, Amoco Production Company
Fred Hilterman, Geophysical Development Corporation
Organizer: Stan Truxillo, Amoco Production Company
Parking: Enter the Westlake Complex from Memorial Drive between Eldridge and Hwy 6, then bear right at the main Amoco entrance, and go through the "tunnel" into the visitor parking area in the garage. Enter the main building (Westlake 1) and the guard will direct you to the Terrace Room.

First Presentation: 4:30 - 5:10 p.m.

Anisotropic Effects on Seismic Data: Times and Amplitudes
by Leon Thomsen, Amoco Exploration and Production Company, Houston

P-wave reflection Amplitude Variation with Offset is a valuable seismic attribute, providing a statistically robust signature which encodes information concerning the lithology and fluid content of the formations immediately adjacent to the reflecting horizon. When empirically analyzed, it has shown, in some geologic provinces, a strong ability to discriminate economically attractive zones from those less attractive.

However, when we attempt to analyze the AVO effect quantitatively, we are immediately led to ask ourselves: "Since we are looking here at an angular

variation in our data, should we not analyze it with a model which includes angular variation of velocity?" It is easy to convince ourselves that the answer to this is: "Yes; if the rocks are seismically anisotropic, this makes a first-order contribution to the AVO effect, even if the anisotropy is weak".

These anisotropic effects include: angular variation of incident energy (even from an isotropic source) anisotropic transform from offsets to wavefront angles anisotropic contribution to the reflected amplitude.

If these effects are in our data, but not in our interpretive model, then it is easy to: mistake anisotropy for hydrocarbons (false positive AVO), or conversely overlook hydrocarbons whose AVO signature is masked by anisotropy (false negative AVO).

While the degree of anisotropy varies from place to place, and may be negligible in some places, the theoretical analysis indicates that the effects are plausibly strong enough so that we should never casually assume that they are negligible.

Second Presentation: 5:10 - 5:50 p.m.

With anisotropy comes lithostratigraphic detection of hydrocarbons
F. J. Hilterman, Geophysical Development Corporation, Houston

Whenever the acoustic impedance values of shales and gas-saturated sands are approximately equal, hydrocarbons are difficult to detect with 3D seismic data. In order to resolve this problem, a 3D AVO study was conducted utilizing numerous borehole information to help calibrate the seismic response to the petrophysical properties. With a modified form of Shuey's equation, the AVO inversion yields two distinct reflectivities, a normal-incidence and Poisson. The estimation of the Poisson-reflectivity section is stabilized by including CDP traces that have offsets as great as twice the depth. This

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requires the inclusion of anisotropic corrections into the total processing flow.

The NI and Poisson reflectivities are then related to chronostratigraphic and lithostratigraphic sections. Lithologic correlation results from petrophysical relationships of SP well-log curves to Poisson's ratio curves while the chronostratigraphic correlation relies on seismic-stratigraphy analysis. The benefits are: A) the lithostratigraphic section contains only very clean wet sand and/or gas-saturated sand events, and B) the chronostratigraphic section is a high resolution structural image.

Interpretation Workstation SIG

Date: Thursday, December 12, 1996

Time: 4:30 p.m.

Place: The Information Store, 10777 Westheimer, Suite 250
Houston, TX 77042, 713/787-6737

Directions: The location for the meeting is approximately four blocks West of the intersection of Beltway 8 and Westheimer. The office is located in the West Chase Center building, which is a twelve story glass building on the South side of the street. At the intersection of Walnut Bend and Westheimer take a left hand turn. On the South side of the office building is a six story parking garage. Take a left on the North side of the garage and go to visitor parking, which is on the first floor. You can park anywhere on the first floor of the parking garage.

Cost: No charge; however, please reserve a place by calling the GSH Office (713-917-0218) no later than noon Tuesday, December 10th.

Committee Meeting: A meeting of the SIG Steering Committee will be held at 3:30 PM prior to the presentation. All committee members are urged to attend.

Topic: Data Access For All In The E&P Workplace

Speaker: Glenn R. Breed Director, The Information Store

Abstract: There are monumental changes happening in the oil and gas industry and in the area of data management that will have an impact on us all. Most of us are currently working in an asset team or will be in the future. Data is now being treated as an asset, data stores are being built at the national, corporate, regional, divisional, and personal level, The Internet and Intranet are becoming part of daily life in many companies.

The question to be answered is, what do all these changes mean to the person using an interpretation workstation to find and produce oil and gas. The presentation will attempt to address the majority of these changes in a general sense, but it will specifically address data access through a single point of entry to many different data sources in different forms, such as physical, digital and analog. A single point of entry is a key for effective data access and this will be addressed and demonstrated at the presentation. The demonstration will include access to core and cutting data, geologic data, production data, seismic locations, and culture on an Interactive Workstation.

Potential Fields SIG

Date: Thursday, December 19, 1996

Time: 5:30 - Social Hour only, no speaker

Location: University Club, 5051 Westheimer, Suite 355

Reservation: Please RSVP by December 10 to: Chuck Campbell, ACCEL Services, Inc., campbell@neosoft.com, or 713-993-0671

Topic: This is our annual Christmas social gathering. There will be drinks, finger food and conversation. We have our sponsors to thank, so please attend and do so in person.

Next Meeting: The HESS building is being sold, so our next regular dinner meeting on January 16 will be held at a new location. Please watch this newsletter for the new location, and directions for finding the venue.

IMPORTANT REMINDER

HESS is relocating beginning in January. All GSH activities starting in January will occur at the new location



OutLook '97

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IBM

Any attempt to peer through the looking glass into the year 2000 must be made with the realization that the future may be the present sooner than expected. After all who would have predicted in 1990 that by just past mid-decade 3D seismic acquisition and processing would dominate 2D by over 3 to 1 or that full 3D marine surveys would be acquired with vessels capable of towing 14 streamers and the majority of processing would occur onboard during collection. The increase in computer power while at a substantial lower \$/mflop has enabled 3D technology to deliver a drilling success ratio to above 60% and repeated collections and processing (4D) is driving production rates upward.

Gains in the near future will be centered in 3 areas. The first is a continued acceleration in computer power available to the geophysicist.

With the computer industry's commitment to delivering a 3 Teraflop computer by year-end 1998 through the Accelerated Strategic Computing Initiative, the ability to do 3D Prestack Depth Migration with ever increasing dataset sizes will become more routine. The capability of scalable parallel computers will also impact reservoir simulations where with the use of new parallel programs near linear speedup is achievable. Whereas 100-200 thousand cells is the current limit on most workstations, using a parallel approach simulations of 5 million or more cells is achievable thereby reducing the need for upscaling.

The second area to benefit is in the use of collaborative computing. Efforts to date to 'share' the work have been limited to company LANs and multi-company ATMs as demonstrated as part of the AIRES project (teams of processing geophysicists at three oil companies and Geco-Prakla worked to define processing steps on data delivered by satellite from Geco-Prakla vessels to their center). In order to find, delineate, and understand the reservoir

collaboratively today requires high-end computing environments at both ends with any changes needing to be made independently. As higher speed links become available (current work is beginning on OC-12 capability to replace existing NSF links) it will be possible to have all changes made at one supercomputing site with the resulting images piped to low cost display stations.

The third area is improved data handling and visualization. Today's geoscientist is faced with an increasing array of information. Beyond multiple 3D images obtained with 4D surveys, multicomponent datasets, AVO analysis, well data and other information is available and necessary to properly understand the reservoir. New techniques allowing the geoscientist to view all of this information together in a manageable fashion is needed. One method to aid in this study is immersive visualization. With the use of CAVEs full 3D representations are capable instead of the two dimensional displays currently in use. Combined with new methods of direct manipulation of the data and a tight coupling to supercomputers, the geoscientist would be able to walk through the entire reservoir making changes to the model and instantly seeing the resulting effects. This immersive approach when used in a collaborative manner with other geoscientists in independent locations will greatly increase the ability to resolve the problem in the quickest manner possible.

Glen Krajca-Radcliffe
Petroleum Product Development Team
Manager
IBM RS/6000 Division

An Independent's Vision For Exploration in the late 90's

In the past 3 years or so a new breed of oil company has developed, a hybrid of major and independent. This new breed is composed of the best and the brightest from the majors, and the cutting edge from the computers. These hybrids are evolving rapidly with the changing times. They are incredibly

aggressive, willing to take risks and have the financial resources to turn the heads of influential people. They are the Microsofts in a world of IBMs.

The vision for this hybrid company is very exciting. These hybrids will be taking on larger and larger projects, the sizes of which were unimaginable only a few years ago - because they can. It is amazing what a few very smart, aggressive and focused individuals along with very fast, data-manageable and cutting-edge computer hardware and software can accomplish. This combination of talents and technology is embracing the dizzying pace of the technology revolution, while the others are not. Try to imagine the difficulties a manager at Exxon or Mobil or any other large oil and gas organization faces as he or she attempts to accommodate the needs of the explorationists. They all have seen the demos at the SEG and want to use Silicon Graphics to visualize their data. They want Voxel-Geo and Earth Cube to run on reality engines. They see the advantages and know there is much more oil and gas to be found in their data. But their company cannot possibly evolve as fast as technology is evolving.

The larger oil and gas companies will see an increasing need to form alliances with these hybrids, particularly in the more mature areas of the world. Major oil companies are focused on finding big reserves in the deepwater Gulf of Mexico and overseas. Their balance sheets are addicted to the large risk, large strike potential in lieu of exploring for the "low-hanging fruit" in previously explored areas, especially in our own Gulf Coast backyard. These alliances will allow (and have already allowed) the hybrids access to many aging properties that were once cash cows for the majors. These areas will be injected with new life as the hybrids imprint their template for exploration. These alliances will also proceed with exploration and exploitation in new underexplored areas nearby. The combination of big company manpower and local expertise, and small company stealth, expediency and efficiency will

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provide for formidable competition. The benefits for both will be impressive in this envisioned symbiosis.

John O. Hastings, Jr.
Geophysicist
EDGE Petroleum

New Era in Seismic Technologies

As we begin the new year, the seismic industry appears poised on yet another era of innovation. Advances are taking place in the areas of survey design, data acquisition, processing, and analysis that could not have been foreseen just a decade back. Described here are some of the new seismic technologies that Western Geophysical will be concentrating its efforts on during 1997 and subsequent years.

4-D Seismic: 4-D or time-lapse seismic surveys offer the potential for increasing our understanding of fluid movements in the reservoir over time. This seismically enhanced reservoir monitoring is based on the principle that changes in the reservoir fluids, temperature, and/or pressure produce acoustic responses that are large enough to monitor with seismic surveys recorded at different stages in the life of a field. Combining the high 1-D resolution of well information near the borehole with the high spatial resolution of 3-D seismic data, it is possible to better determine and visualize how reservoir fluids are moving between wells in the complex process of hydrocarbon recovery. As the acoustic response is fundamental to the 4-D method, Western Geophysical, in association with the Alberta Research Council, has produced a comprehensive database documenting the acoustic response of carbonate and clastic rocks to various production processes. To analyze the results of time-lapse surveys, Western is now offering the patented Lamont 4-D software developed by the Lamont-Doherty Earth Observatory in conjunction with a consortium of oil companies. The software has been tested in 15 oil fields in the North Sea

and the Gulf of Mexico and is being used in many of the active 4-D projects.

Solid Streamer: Western Geophysical has developed a new method for incorporating seismic sensors in streamers made of a solid, flexible material. The major advantages of the solid streamer are its buoyancy, strength, and reliability. It is possible to retract the streamer while the vessel is still moving forward. If the streamer is severed in water for any reason, it floats to the surface, making retrieval highly convenient. The solid streamer also eliminates the time spent in adjusting the amount of fluid in oil-filled streamers for variations in temperature and salinity. Recent tests have shown the solid streamer to be less prone to cable-related noise, allowing it to be used in higher sea states.

Ocean-Bottom Cable (OBC): Western Geophysical's OBC surveying methodology overcomes the practical and technical challenges posed by the shallow-water marine environment and surface obstructions. Proprietary Dual Sensor SM processing is used to scale and combine the hydrophone and geophone data sets to remove receiver ghosts and water-column reverberations. An added benefit of Dual Sensor data acquisition is that we are able to capture the widest seismic bandwidth in the marine environment. The combination of OBC data acquisition and special static processing has enabled Western to provide reliable results in what were previously no-data-zones, such as the South Pass region of the Gulf of Mexico.

3-D Depth Imaging: In many areas of complex geology, optimum reservoir exploitation has been limited by the lack of reliable seismic data. Taking advantage of new computing and visualization technologies, Western Geophysical has developed a suite of depth imaging tools that includes prestack and poststack depth migration algorithms, multiple attenuation, and proprietary software for velocity analysis, geologic modeling, and 3-D visualization.

Through a careful analysis of the geologic objectives and a step-by-step modeling process, it is possible to select

the right combination of tools to ensure imaging success at the lowest possible cost. For many prospects, 3-D poststack depth migration provides an affordable and timely solution. If finer detail is desired, poststack migration can be run as a precursor to prestack depth migration for deriving initial estimates of the subsurface model. Western Geophysical is using iterative 3-D post and prestack depth migration to obtain accurate images of reservoir zones beneath a complex overburden in a variety of geologic settings, including fault-shadow problems, the Gulf of Mexico subsalt play, the North Sea, and the Middle East.

Azimuthal P-Wave Analysis for Fracture Detection: Until recently, fracture detection required the use of costly and complex multicomponent shear-wave technology. Western has developed a patented P-wave fracture detection method that provides faster and simpler acquisition and processing, reduced costs, and better data quality. Western's approach assists in the detection of fractures through the collection of an adequate number of source-to-detector azimuths.

Infield Data Processing: Advances in computing portability and data communications now make it possible to reduce the exploration and production cycle from a matter of years to months. To expedite seismic surveys, Western Geophysical is incorporating data processing capabilities in the field on land and offshore. Depending upon client requirements, it is feasible to ensure infield validation of data quality, conduct data processing, and generate 3-D data cubes to allow on-site prospect interpretation. Communication networks may be used in transmitting data to processing centers and even client offices. The end results are faster project completion and accelerated drilling recommendations.

By Craig Beasley
General Manager Research &
Development
Western Geophysical

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Future Employment Trends

It looks like the oil business is on an upward climb again! Offshore rig utilization has been firmly above 84% worldwide since late spring. . . and close to 95% percent in the Gulf of Mexico. Highest bidders for oil and gas fields have lately been paying 115% to 175% above previous valuations right here onshore Texas. Booming Pacific Rim populations (with expectations) are firming up demand. Prices for crude oil and natural gas are much steadier than a year ago, with a perceptible upward slope (we hope!). So things are looking up overall.

Two trends seem to be changing the work relationships between consultants, employers, and employees. One is a shift of mid-career geoscientists out of major and large independent oil companies and into consulting as individuals or with consulting groups. The other is a shift in the age distribution of our profession. For the last decade or so geologists and geophysicists have come in two "lumps" of ages - those who entered the industry in the 1950's and 60's (Pre-Boom) and a younger group who came in the late 1970's through the mid 1980's (Boomers - baby and oil). In the next few years the first lump will be leaving the business to the second group who are now entering their mid-career phase (and their 40's). There does not seem to be enough students in the pipeline to make up for the folks retiring or the mid-career people leaving the business.

The industry's response to increasing work to be done, decreasing numbers of professionals to call on, and the shifting age distribution of available geoscientists will be interesting. We are, after all, in a knowledge business applied to mineral extraction - reserves have to be replaced or companies lose value. Between the retirement of our mentor group and the low numbers of students coming onboard, who knows - we may be entering a period of labor shortage for the first time in 15 years.

Sam LeRoy - EarthView Associates

Offshore Energy Center Call for exhibit items

SEG, through the SEG Foundation and Trustee Associates Program, has evaluated the Offshore Energy Center (OEC) potential as a medium to increase the public's awareness of the contributions of geophysics to the offshore effort, of career opportunities in the geophysical industry, and to enhance the image of the profession. The OEC was organized in 1989 to educate visitors about offshore operations from exploration to distribution of oil and gas. A fully functional jack-up offshore drilling rig, at Pier 19 in Galveston, Texas, is being converted into a 12 000 ft², three-level exhibit facility that will complement the Weiss Energy Hall at the Houston Museum of Natural Science by providing education and public affairs programs about offshore operations to the general public and government entities.

SEG will contribute financial assistance to OEC and provide a significant exhibit of geophysical equipment and technology. Several items and/or displays have been suggested and individual and corporate SEG members are hereby invited to nominate items for inclusion in the exhibit. With the reminder that this is not a museum of geophysical history but rather of current technology and equipment, (as seen, for instance, at the SEG International Exposition), members are invited to provide photographic and/or narrative descriptions of items for the committee's consideration. Emphasis will be placed on displays or interactive current acquisition, processing, and interpretation methods as can be exhibited in a 27 x 40-ft space. Contributing companies will be recognized. Items should be forwarded to Hugh W. Hardy, chairman of the OEC (Geophysical) Exhibit Committee, at 5626 Rutherglenn Drive, Houston, TX 77096.

Thom Tucker - Century Technical Group

Schlumberger

The oil and gas industry is demonstrating renewed growth after a difficult period that lasted almost 15 years. There is rising global optimism about the future. Worldwide economic expansion has caused the demand for crude oil to increase by 1.5% to 2% per year. At the same time, reduced E&P spending since the mid-1980s has resulted in today's situation, where excess crude production capacity is less than 10% of total production, the lowest level since the 1970s. Between now and the turn of the century, E&P investment will increase dramatically.

There have been many changes in the oilfield service industry in the last 5 years. The main change is that oil companies have increased their focus on efficiency as a primary driver in the success of their operations. They are concentrating on their core activities and outsourcing those operations not

considered critical. The resulting partnering with service companies to find solutions to particular problems is reflected in the increased profitability of oil companies.

Schlumberger has changed to meet this need. We now have seven oilfield service product lines to cover the wide range of services needed by our clients. Our challenge is to provide a seamless interface to our clients while internally maintaining a clear focus on the direction of each product line. The significant improvements in efficiency and bottom-line cost we have achieved in our major alliances prove that this is a powerful way of doing business.

The next 3 to 5 years will see strong growth in the oil and gas industry, particularly in North America, Latin America, the North Sea and Russia. The U.S. Gulf Coast will operate near the capacity of the rig fleet, both on the shelf and in deep water. Technology will be pushed to the limit as companies go after reserves that are increasingly

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OutLook '97

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more difficult to produce. This is an exciting time to be a part of the oil and gas business.

Rod Nelson
Schlumberger Wireline & Testing
VP Marketing - North America

Vision

At 3DX we are looking forward to 1997 as another year of growth. In 1996 we shot two times as many square miles of 3-D as in '95 and drilled six times as many wells. In 1996 we doubled our compute capacity, halved our project turnaround time and made significant strides forward in our processing capabilities, particularly in the area of migration velocity analysis and depth migration. We expect this trend to continue in '97 on all fronts.

We plan to acquire more seismic, drill more wells and grow our technology. These are exciting times for smaller independents working domestically. A unique set of circumstances has put land, capital and the technology to exploit them both within our grasp. Hold on tight it's going to be a great ride.

Peter M. Duncan
3DX Technologies Inc.

The Future

In a rapidly changing global environment, core technical competencies and technology may no longer be the key for achieving a sustainable competitive advantage - this will be a given. This advantage will probably be achieved through SPEED of evaluation and decision making within an environment of MUTUAL TRUST

The future will most likely have the following attributes:

- \$\$\$ Focus
- Quality will be a given
-Review teams become unnecessary
- Delegation to Team Level
- Global, flexible organization with virtual team
- Consolidation within the industry
- Increased use of generalists (experts who wear many hats)
- Trades and deals more prevalent

Today, Sterling performs consulting services exclusively to the oil and gas industry, which includes Best practices, asset appraisals, strategy design and implementation, competitive analysis and acquisition and diversitive analysis.

Jeff Brookman
Sterling Consulting Group



Photos From The Shrimp Boil '96



Alf Klaveness is Thinking Big

How about a continuous seismic line from the Atlantic to the Pacific Oceans through the Northwest Passage?

One of our GSH members, Alf Klaveness, a former Destroyer Commander in World War II convinced the U.S. Navy (perhaps "a part of the Navy" would be more accurate) that this would be a practical and appropriate project to undertake at this time.

The U.S. Navy is actively engaged in specialized marine seismic operations, however, these are related principally to Anti-Submarine Warfare (ASW) research. Consequently, the Navy would not normally undertake a project to "shoot" a seismic line through the Northwest Passage. Besides, waters there are largely covered with ice during much of the year and can not be transited by conventional vessels.

However, precisely for that reason, the Navy is considering such a project. Alf has proposed a plan to the Department of Defense and other interested Departments (Navy, Coast Guard, Commerce, Transportation and Maritime Administration) to convert one or two of the Iowa Class battleships (Iowa, New Jersey, Missouri and Wisconsin) to giant icebreakers which could be used there to open and maintain an Arctic Seaway between the Atlantic and the Pacific Oceans. This would supplement and perhaps replace the Panama Canal.

It should be noted that a similar proposal was made shortly after World War II. Then, as a Destroyer Commander in the process of decommissioning and preparing our ship for long term storage, Alf additionally served on a multi-service committee to consider the establishment of a national security "screen" in the Arctic area. Since Alf had become well acquainted with the performance of the Iowa Class Battleships while providing antisubmarine and anti-aircraft support for them and other vessels of the Pacific

Fleet, he submitted the original of this proposal to the committee. This was considered carefully and nearly adopted. However, at that time in our history it was decided, perhaps wisely so, that these Battleships were too valuable from a national security standpoint to be modified and used for that purpose. Instead, the committee recommended that land based observation posts (DEW Line) be constructed and manned to meet our security requirements in the Arctic. This plan was adopted and later implemented.

Circumstances are very different now. Soon we will lose control of the Panama Canal. Security there may be reduced or eliminated, leaving that vital water way vulnerable to attack by terrorists (one ship strategically scuttled there could block its use). Furthermore, some of our principal military and commercial vessels are now too large to transmit that essential waterway even if it is available when needed. Additionally, important supplies of hydrocarbons and other critical minerals (copper, molybdenum, barium, silver) have been discovered on Arctic Islands but can not presently be recovered without the use of powerful icebreakers to convoy ore vessels and oil tankers through the Northwest Passage.

With appropriate modifications, the Missouri and the Wisconsin, would be ideally suited for providing that important service. Such modifications would consist essentially of: 1. Replacement of the bulbous underwater bows with overhanging ice breaker bows, 2. Construction of steel cages (ice shields) around the propellers. With their considerable power (248,000 H.P.), their massive weight, their natural momentum, their torpedo shielded hulls, and their sonar systems, they could become the world's largest, most powerful and most useful ice breakers.

The reactivation and modification of these vessels would, no doubt, be justified by the commercial and military benefits derived from their use here, including a shortened and defensible polar sea route between the Atlantic and the Pacific Oceans.

It is significant to note that the feasibility of the proposed project was demonstrated in the Autumn of 1969 (2 September to 12 November) when the S.S. Manhattan, an oil tanker, was outfitted with an icebreaker bow and successfully transited the Northwest Passage from the Atlantic Ocean to the Pacific and then returned to the Atlantic.

Research indicates that an Arctic seaway between the Atlantic and the Pacific Oceans has been the hope of many nations for a century or more, and that it is needed at this time more than ever before.

This, in addition to providing improved security for our nation and the world, would open a shorter and more defensible seaway between the Atlantic and the Pacific Oceans for military and commercial purposes. At the same time they could provide a platform for acquiring useful seismic baseline through the Northwest Passage by periodically deploying expendable/retrievable sonobuoys instead of pulling ice destructible hydrophone cables.

Now, with the support of the Department of Defense, the Department of Commerce, the Department of Transportation, and with principal funding from industry, this important endeavor may finally be implemented and possibly ranked with some of the world's major accomplishments.





More Photos From The Shrimp Boil '96

IMPORTANT REMINDER

***HESS is relocating beginning in January.
All GSH activities starting in January will occur at the
new location***

5430 Westheimer
"The Old Carlyle
Restaurant"

YORKTOWN

CHIMNEY ROCK

WESTHEIMER

610

RICHMOND

