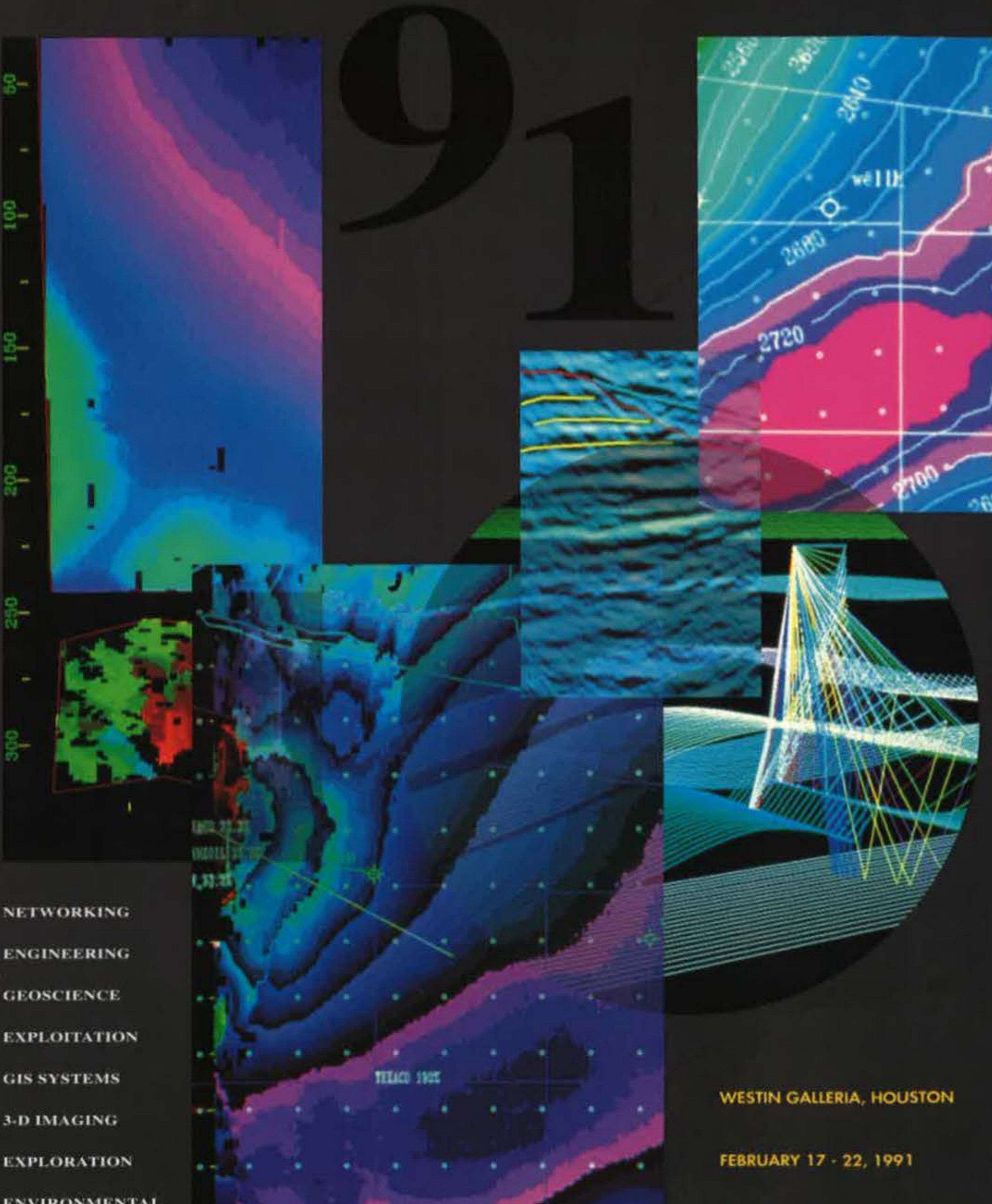
HOUSTON GEOTECH

TECHNICAL CONFERENCE



NETWORKING

ENGINEERING

GEOSCIENCE

EXPLOITATION

GIS SYSTEMS

3-D IMAGING

EXPLORATION

ENVIRONMENTAL

COMMUNICATIONS

3-D CIRCLE SHOOT

WESTIN GALLERIA, HOUSTON

FEBRUARY 17 - 22, 1991

FOR INFORMATION

CALL 713.739.3165

IMAGES: LANDMARK GRAPHICS
PRINTING: ASAP/TREATY OAK PRESS
DESIGN: HOUSTON CREATIVE CONNECTIONS
SEPARATIONS & PAGINATION: DIGITAL CHROMATICS, INC.

VISUALIZATION PROGRAM

Galleria III - Third Level

Visualization Technology for Exploration: Theory & Applications of Visualization and 3-D Computer Graphics in the Oil and Gas Industry. A Two-Day Technical Symposium Convened by John C. Pohlman, ExplorTech Computer Applications

"Scientific Visualization" and "Visualization Technology" have become often-heard "buzzwords" in the exploration industry, but what exactly is "Visualization" and how can its applications in 3-D computer graphics on today's exploration workstations assist you in the task of finding oil and gas? Geotech '91 offers a two-day seminar featuring speakers drawn from the scientific community, software developers and vendors, and working professionals from major oil companies to address the definitions and uses of visualization in exploration and production.

More than twenty invited professionals will discuss the basics of scientific visualization, how the concepts of visualization are applied in computer graphics, why computerized visualization technology is of value to today's geoscience professional, and will showcase some of today's most advanced applications of visualization technology for the exploration industry. The symposium will be concluded with a ten-member round table discussion on the value, uses, and probable future development of visualization technology in exploration.

This symposium is designed for the geoscientist at all levels of sophistication and experience from novice users through experienced computer professionals and software developers. The session will help you focus on the significant applications aspects of visualization as it will effect you, the working geoscience professional, and will help you to better understand how this important and rapidly developing technology can enhance your chances of finding and producing oil and gas

Note: The Silicon Graphics Computer Systems, Inc. Demonstration Van will be available all day Monday - Friday, for demonstrations of many of these products.

Session I - Scientific Visualization In Exploration & Production

8:00 am **Opening Remarks**

8:15 am **Keynote Address:**
Advanced 3-D Visualization Applications for Improved Oil and Gas Recovery
Dr. Marcus E. Milling, Associate Director, Texas Bureau of Economic Geology, Austin, Texas

9:15 am **Visualization of Map and Seismic Attributes**
Dr. Roice Nelson, Founding Partner (Speaker) and Susan Mastoris, Market Development Geophysicist, Landmark Graphics Corporation

10:00 am **Volume Rendering - A New Advancement in 3-D Geophysics**, Dr. Vincent Argiro, Founder, Chairman, and Chief Technical Officer, Vital Images, Inc.

10:45 am **Enabling Technologies for the "Next Generation" of Exploration & Production**, Stephen L. Goldsberry, Geosciences Marketing Manager, Silicon Graphics Computer Systems.
(Two segments to continue in the Demonstration Van which is located across the street from the Alabama entrance to the Westin Galleria Hotel.)

12:00 Noon - 1:30 pm Lunch Break

Session II
Visualization And Computer Graphics

1:30 pm **Real-Time Interactive 3-D Modeling For Interpretation**, Dr. Stephen W. Thomas, President SciVision, Inc.

2:00 pm **A Mapping Approach to Three Dimensional Modeling**, Dr. Robert C. Belcher, Senior Software Designer, Dynamic Graphics, Inc.

2:45 pm **3-D Visualization in Areas of Complex Geology**
Robert Q. Wales (Speaker), Geoscience Applications Engineer, Integraph Corporation and
Thomas J. Fisher, Senior Staff Scientist, Radian Corporation

3:30 pm **An Interactive 3-D Modeling System for Integrated Reservoir Interpretation**, Thomas J. Lasseter, President, Tech-Logic, Inc.

4:15 pm **Computer-Based Graphical Restoration of Growth of the Hainesville Salt Dome, Wood County, Texas**
Dr. J. H. Howard, Consultant Geologist, CogniSeis Development Corporation.

Manpower Requirements For CAEX And Workstations

Bob Marcum, The UNIX Solutions Group

Mr. Marcum will detail the skills required by users, administrators, and developers of Computer Aided Exploration systems and workstations used in geophysical applications. Additionally, methods for determining manning requirements CAEX and workstation environments will be presented. Approaches to planning and budgeting for adequate manning in these critical areas will be proposed, based on the relative availability of these skills in the market place. Examples of applicable salaries in the Houston market will be shown. The presentation will include a discussion of the specific technology changes which are impacting these skill and manning issues.

Bob Marcum is a UNIX Consultant and Manager of the UNIX Solutions Group, a UNIX skills consulting company.

Visualization Of Map And Seismic Attributes

Susan Mastoris, Carl Huxohl, and H. Roice Nelson, Jr.

New map and seismic attributes have been developed for use on interactive seismic workstations. These techniques were applied to the interpretation of both geologic structure and stratigraphy from 3-D seismic surveys from Canada and the Gulf of Mexico. In both of these geological domains the new attributes provided new information leading to a more complete and accurate interpretation. We will first describe the seismic attributes used to assist identification of reservoir reflectors, and then describe the map attributes and how they aided the interpretation. Specifically, we show how these map and seismic attributes explained why wells in one part of a project area were more productive than those in other places in the project, and how this interpretation formulated new leads for additional well locations.

The new seismic attributes used included Response Phase, Response Frequency, Group Section, Perigrams and the Product of the Group Section and the Perigram. These attributes supplement the most commonly used seismic attributes: Reflection Strength, Instantaneous Phase, Instantaneous Frequency and Apparent Polarity.

In reservoir studies it is often useful to use seismic attributes as a means of adequately describing the areal distribution of reservoir characteristics that can be tied to a specific seismic attribute. Reflection Strength has been used to delimit the extent of seismic amplitude anomalies. This attribute will reveal gross reservoir characteristics such as continuity, local thickness and lithologic variations, but will seldom reveal fluid variations. Constructive and destructive tuning of wavelets, generated form the top and base of a unit can provide a signature for a particular reservoir, showing either a loss or a gain of strength as compared to the background. Instantaneous Phase has proven useful in highlighting the downdip limit of gas reservoirs with a phase reversal. Since phase ignores amplitude information it enhances reflector continuity, showing subtle depositional features. Regional and prospect stratigraphic relationships can be studied in more detail with phase sections, sometimes even highlighting fluid contacts. Instantaneous Frequency should reveal variations in bed thickness and prod changes in depositional patterns. For example sometimes frequency tuning at the updip limit of stratigraphic pinchouts can be found. There are also high frequency absorption examples, forming shadow zones beneath gas reservoirs. Apparent Polarity reveals the sign of the seismic trace when Reflection Strength has a maximum value, defining whether a particular reservoir has a positive or a negative reflector. Reservoirs with similar geology, but different apparent polarity can be an indication of processing problems.

We show how Response Phase and Response Frequency create displays similar to Instantaneous Phase and Instantaneous Frequency, but do so with respect to the seismic data's energy envelope. The Response Phase tracks the phase changes from trace to trace, while the Response Frequency tracks the change in dominant frequency. Since Response Frequency, measuring only one constant mean frequency, finds the values associate with the peak and returns those values as a constant across the width of the envelope, the resulting display can appear quite broken and choppy. The Group Section attribute, or normalized trace section, is the cosine of the phase component of the seismic data. This attribute shows the distribution of energy concentrations and offers an indication of reservoir homogeneity. The Perigram represents the low cut version of the envelope of the seismic energy, showing areas of continuous phase correlation and inferring smooth subsurface boundaries. The Product of Group Section and Perigram simply weights the phase character with the energy in the envelope and smooths the appearance of the Perigram. These attribute displays can be used on both prestack and poststack sections. However, the visual impact of these seismic attributes will be demonstrated on post-stack seismic sections across a specific reservoir, showing how the reservoir is recognized in strike, dip and map views.

The first interpretation step was to identify the reservoir reflectors using these seismic attributes and well data. Each horizon was manually picked on several lines, and then automatically tracked across the entire 3-D survey using a 3-D autotracking program. The use of the autotracker ensured consistency and maximum accuracy (i.e., consistent picks on the maximum of the minimum phase amplitudes). The mapping attributes calculated and used included: Difference, Dip, Azimuth, Edge Detection and Amplitude Extraction displays. These were calculated on interpreted horizon surfaces from a 3-D seismic survey.

The Difference and Dip displays calculate the change in the amount of dip in milliseconds, either in a 3-D sense (Dip), or in a 2-D sense, calculated in a given direction (Difference). The Azimuth display calculates the change in the direction of dip in degrees, while the Edge Detection display applies a 9-point filter to highlight only the areas where the dip changes abruptly. Amplitude Extraction is a standard map of seismic amplitudes, or some other seismic attribute, extracted from the seismic data along the horizon travel-time surface. A parabolic fit is applied to clipped amplitudes for resolution greater than the sample rate of the data. Results of extracting amplitudes from data volumes of the new seismic attributes described above will be shown.

A Canadian reef play example showed dramatic results of applying these attributes. A 3-D survey was shot over this area to better delineate the shape of the reef and to explain why some wells were successful while others were dry, even though all wells were situated on the reef. The resulting 3-D structure map showed a much better defined outline of the reef compared to the original 2-D interpretation, but failed to explain why the wells on the crest were dry. It was only after calculating Amplitude Extraction that the answer became obvious: production was related to high porosity zones found at different locations along the crest. Low seismic amplitudes corresponded to the high porosity zones, so a color coded amplitude map revealed the areas with porosity that directly correlated to the productive wells. The dry holes directly correlated to the low porosity zones, shown as high amplitudes on the Amplitude extraction map. In conjunction, the azimuth map showed a trend where all the productive wells lined up along the upper backside of the reefal crest, relating the high porosity zones to the bend in the reef structure. The Dip and Edge Detection maps both clearly outlined the different parts of the reefal complex: the basin, reef edges, reef crest, and lagoonal area.

Another example was a heavily faulted region in the Gulf of Mexico. Previously, each fault had to be manually picked and correlated on a line by line basis. The map attributes, however, instantly displayed linear patterns depicting the complex trends. By selecting and manipulating different colors, even minute faults and cross-faults became obvious. Although small, these faults may still be prominent enough to control the amount of production well to well.

An Expert Expert

Dione McBride, McBride Consulting Service

This talk will be an elementary approach to developing an expert system. Using Level 5 from Information Builders as an example of expert system shells available on the market, Ms. McBride will discuss a methodology for developing a backward chaining model. Using this approach, she discusses the Expert Expert, a small expert system to use to decide if a project can be handled by a rule-based system. During the course of the presentation, some AI terminology will be discussed, as well as a discussion of sources of information and human experts.

Advanced 3-D Visualization Applications For Improved Oil And Gas Recovery

Marcus E. Milling, Bureau of Economic Geology, The University of Texas at Austin

Advanced 3-D imaging technology is required to optimize and improve discovery and recovery of remaining oil and gas resources. Emerging new interpretation systems must be able to rapidly integrate and synthesize geological, geophysical, and petroleum engineering to provide higher resolution models of hydrocarbon traps and reservoir frameworks. Prediction of the occurrence, distribution, and external geometry of hydrocarbon traps is required to improve assessment of undiscovered resources and increase extension exploration success. Additionally, advanced reservoir characterization models must be developed that more accurately display internal framework architectures. In particular, to maximize recovery from existing fields we must be able to improve prediction of the distribution of sealing faults, internal reservoir heterogeneities, and patterns of diagenetic overprints at the interwell scale. With development of improved interpretation and modeling systems, we can more accurately contact undrained fault blocks, delineate stratigraphic traps, flood bypassed lower permeability intervals, and test deeper field pays. Advanced 3-D interpretation techniques will allow us to strategically target extension exploration and development infill wells to optimize recovery of remaining hydrocarbon resources.

Improved Query Techniques For The Geologist

Mark S. Molnar, ZYCOR, Inc.

Geologists typically spend over two-thirds of their time bringing together the data required to complete a mapping project. The application of relational database technology to this problem provides significantly improved organization and retrieval for the geologist, data retrieval or "query" techniques are required which facilitate easier and faster data access than that available through standard SQL. Towards these ends, the authors have developed "Query Builder and "Query by Object" capabilities.

VISUALIZATION TECHNOLOGY FOR EXPLORATION AND PRODUCTION

Houston Geotech 1991 Technical Symposium

Monday, February 18

Morning, Session #1: Basics of Scientific Visualization in E & P: What is it and How can I benefit From it?

0815: Session Convenes - Opening Remarks

0830: Keynote Address:
3-D Visualization in Geology
Dr. Marcus Milling, Texas Bureau of Economic Geology

0910: *Visualization of Map and Seismic Attributes*
Dr. Roice Nelson, Founding Partner, (Speaker) and Suzy Mastoris, North American Regional Geophysicist, Landmark Graphics Corporation

0950: {possibly Charles Fried}

1030: no title yet
Tom Guidish, Senior Geophysicist, WesTek Division, Western Atlas International

1110: *Hardware Development for 3-D Visualization*
Mr. John Flynn, General Manager of Geoscience Development Silicon Graphics Computer Systems (Speaker??)

Lunch Break 1200-1330

Afternoon, Session #2: Visualization and Computer Graphics

1330: Session Convenes

1330: *Visualizing the 3-D Interpretation Model.*
John Pohlman, ExplorTech Computer Applications & Steve Thomas, SciVision

1410: no title yet
Dynamic Graphics, Inc.

1450: *Rational Splines and Multidimensional Geologic Modeling*
Robert Q. Wales (Speaker) and Thomas J. Fisher
Intergraph Corporation

1530:

1610: