Recognition of the turbidite nature of many petroleum-producing sands worldwide makes it imperative to understand both the facies types encountered and the trap types to be anticipated in future exploration and development work. Several facies models have been proposed, most of which are not readily usable with the data generally available in subsurface work. The facies analysis presented examines large-scale controls, such as climate, provenance, basin geometry, and tectonics, and then considers the various large to small-scale facies and sand-body geometries that result. Use of wire-line log pattern, dipmeter, and core descriptive data as criteria is emphasized. The newly recognized meander channel facies is shown to be important in prograded muddy slope areas. The concept of a "facies" as referring to a mappable assemblage of beds of varying natures and origins is favored, in contrast to the practice of assigning a separate facies designation to each single successive bed, with resulting uncertainty as to overall significance.

The author's trap-type classification, which includes canyon-dependent, fan-dependent, anticline-dependent, fault-dependent, and uplift topography-dependent traps, is used in conjunction with the facies analysis to predict the trap types most likely to be encountered in the various facies and basin settings. The trap classification itself is developed as a predictive tool rather than as a pigeonholing exercise.

WHITTAKER, ALUN, and RAFAEL GURVIS, Exploration Logging Inc.

Wellsite Geochemical Analysis in Frontier Exploration—Logistics, Benefits, and Examples

In the past 10 years, organic geochemistry has become an increasingly significant factor in petroleum exploration. In frontier exploration areas, the need for geochemical data during drilling operations, rather than months after a well is finished, is now well appreciated. Real-time geochemical data have proven to be an important additional parameter in exploration and well completion decisions.

Wellsite geochemistry mandates unique operational, technical, and data interpretation requirements. However, the timely nature of data availability during drilling operations as well as the ability for field geochemists to work closely with other wellsite personnel greatly enhances exploration efficiency. Sample procurement, preparation, and selection can be much more accurately realized by personnel familiar with local geology and a specific drilling operation. Furthermore, sample contamination by drilling fluid additives is more easily prevented, detected, and isolated from fresh samples at the wellsite.

YOUNGBERG, A. D., Laramie Energy Technology Center, Laramie, WY, and E. BERKMAN and A. ORANGE, Emerald Exploration Consultants, Inc., Austin, TX

Location of Burns and Faults at Hanna Underground Coal Gasification Area by Use of High-Resolution Seismic Survey

In November 1980, a high-resolution seismic survey was conducted at the Hanna underground coal gasification area. The objectives of the survey were to locate and characterize the burn cavity at the Hanna II, phases 2 and 3 gasification site, and to locate shallow geologic faults. Seismic data acquisition and processing parameters were specifically designed to emphasize reflections at the shallow, 200 to 500 ft (60 to 160 m) depths. A three-dimensional grid of data was obtained over the burn zone. Processing included time-varying filters, deconvolution, trace compositing, and two-dimensional, areal stacking of the data in order to identify anomalies. An anomaly was clearly discernible resulting from the rubble-collapse void in the burn zone. The anomaly was studied in detail and compared to synthetic models. The fault system was found to be a graben complex with antithetic faults. The fault system contains folded beds. A series of anomalies was discovered on the northeast end of one of the seismic lines. These reflections have been identified as underground mine adits from the old Hanna No. 1 coal mine.

AAPG RESEARCH CONFERENCE
Interactive Computer Applications in Petroleum Exploration
Keystone, Colorado
May 9-12, 1982

Abstracts

BANKS, RICHARD B., and JOSEPH K. SUKKAR, Scientific Computer Applications, Inc., Tulsa, OK

Complex Subsurface Analysis Using Interactive Modeling and Simulation Techniques

Many offshore producing regions (and some onshore regions, such as Prudhoe Bay) are complicated by dual nemeses: intersecting non-vertical faults and directional well bores. Fault occurrences are observed in well bores or on seismic lines. When many fault occurrences are present, it often is difficult to determine which fault cuts are associated with which faults. An interactive contouring system allows the user to try various ways of connecting fault occurrences to form (intersecting) fault surfaces in (subsurface) space.

Once the faults have been modeled, the next task is to model (reconstruct, contour) subsurface formations as they interact with the various faults. This task is difficult enough when there are many formations and many faults. The task is even more difficult when directional wells are involved, since isopachs needed for reconstruction (i.e., stacking) are hard to determine.

A multi-surface multi-fault contouring system is being used to perform these complex subsurface analyses. A case study from offshore Gulf Coast illustrates its use.

CARLBOM, INGRID, Schlumberger-Doll Research, Ridgefield, CT

Dipmeter Advisor Expert System

The dipmeter services offered by Schlumberger consist of measurements made in a well bore to determine the inclinations, or dip, of the bedding layers penetrated by the well. The measurements are represented on a log in the form of arrow plots, which indicate the magnitude and direction of the dip as a function of depth. Information about the underground structure and stratigraphy can be derived from arrow plot patterns on the dipmeter log in conjunction with other types of data from the borehole as well as some general knowledge of the geological area. Traditionally, interpretation of dipmeter data has been made by a human expert who identifies and decodes the arrow plot patterns.

The Dipmeter Advisor system is an application of artificial intelligence and expert system techniques to dipmeter log inter-

pretation. It incorporates the inference and knowledge of human dipmeter experts. The first prototype system, which was completed in December 1980, consisted of interpretation in marine environments, but recently the system has been extended to continental and transitional environments as well.

The Dipmeter Advisor system has a highly interactive graphics user interface. During the interpretation, the user has access to the arrow plot data and other related well data through a graphics display screen. The interpretation is made in a sequence of passes over the data, each pass arriving at some conclusions based on user input, combined with applications of the rules of dipmeter interpretation and of pattern recognition algorithms in previous passes. The partial results are displayed on the graphics screen for user verification and the user can, with graphics interaction devices, make any additions, deletions, and modifications of the results in each pass. The final output of the system consists of a log annotated much in the same way as dipmeter logs are currently annotated by human experts.

Several aspects of the Dipmeter Advisor system will be described: the system organization, the graphics interface, and the general form of the rules and the inference structure. The operation of the Dipmeter Advisor system will be demonstrated with an example of dipmeter interpretation.

CRANE, DAVID C., Consultant, Dallas, TX

Microcomputers in Exploration—A Survey

The author has contacted about 50 geoscientists who are using "personal" microcomputers (micros) in their profession. They include respondents to notes in the *AAPG Explorer*, people referred by members of the AAPG Committee on Computer Applications to Geology, and numerous other members of the AAPG and SEG whose assistance is gratefully acknowledged.

Microcomputers have been widely available for only about five years. Software sophisticated enough to realize their potential has been slow to appear, but a surprising number of geoscientists, including independents and consultants, now wonder how they ever survived without computers. Reported applications areas range from word-processing, production accounting, and financial analysis of prospects to log analysis and creation of synthetic seismograms. System costs range from under $2,000 to over $30,000 *plus* software.

Explorationists involved in the rapidly growing use of micros are invited to submit their names, addresses, applications, system descriptions, and interests to the Committee on Computer Applications to Geology for inclusion in the next survey mailing. The first survey and mailing list are being made available as part of this paper.

DOWNING, JAMES A., ZYCOR, Inc., Austin, TX

Interactive Gridding

Gridding of geologic or geophysical data is at the foundation of most computerized mapping and modeling operations. Surface display techniques such as contouring, fish-net isometrics, and cross sections are usually derived from gridded surface models. Processing and analysis techniques such as surface filtering, trend analysis, Fourier transforms, and simple algebraic combinations of surfaces use gridded models in intermediate steps.

A combination of conventional gridding techniques with interactive control for manual interpretation of data hold the potential for dramatically improving results and expanding acceptance of the technology. Several conventional algorithms are reviewed and two new gridding techniques are introduced. Procedures for interactively controlling gridding techniques and adapting the techniques to respond to manual interpretations of the data will be discussed. Also, procedures for intractively adjusting gridded surfaces to conform to manually input contour curves will be described and demonstrated.

DUDA, RICHARD, Fairchild Laboratory for Artificial Intelligence, Palo Alto, CA

An Overview of Rule-Based Expert Systems

One of the more successful applications of artificial intelligence techniques has been the development of programs that have come to be known as rule-based expert systems. These programs encode knowledge about specialized problem areas in the form of sets of if-then rules, typically obtained by interviewing people who are specialists or experts in those problems. The rules can then be used by the program to solve similar problems. The modular structure that results allows incremental development, leading to performance that continually improves as the rule base is expanded.

Most of the rule-based expert systems that have been developed to date have been designed for problems in medical diagnoses. However, among several efforts that are relevant to the petroleum industry, a program called Prospector has been developed for the U.S. Geological Survey for certain problems in hard-rock mineral exploration, and a program called the Dipmeter Adviser has been developed by Schlumberger for the geological interpretation of dipmeter data. This presentation will describe the basic principles behind all such systems and will summarize the current state of the art.

DUPREE, R. L., Amoco Production Co., Tulsa, OK

Highly Interactive Contouring Systems

Computer contour systems are intended to aid in the interpretation of geologic data as well as to prepare drafted quality displays. To accomplish this, completely automated (batch) contour systems require complex algorithms and a significant amount of computer resources. Multiple submissions are also usually required to obtain a finished display.

A highly interactive contour system, however, relies much more heavily on the interpreters and the graphical functions of an automated drafting system to prepare a finished display. This approach uses simpler algorithms, less computer resource, and more interpretative interaction from the end user. Examples of the two approaches include the use of color schemes for displaying results.

HILDEBRAND, H. A., CYBERAN Corp., Houston, TX

A Microcomputer Workstation for Interactive Geology and Geophysics

The capabilities of a new microcomputer system are reviewed. This system allows easy data management for both geologists and processing geophysicists. Currently available peripherals include a digitizer, pen plotter, raster graphics printer, and graphics video. Communications allow hardwired or modern access to other computers.