The application of software centers around a unified data management system and is extremely menu oriented, allowing easy use by personnel unfamiliar with computers. Applications software serves to assist in data acquisition, quality control, and computation for both seismic processing and interpretation. These applications include handling of such data as geometry, velocities, and muting, as well as geologic applications such as digitizing horizons, storing and plotting regional data, and digitizing and processing well log data.

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Future Interpretive Techniques

Over the next few years, interpretive techniques in petroleum exploration will be affected considerably by online graphic methods. A major trend has already started in this area as the industry strives to bring both exploration data bases and applications to the interpretive level. Much of the current work involves the conversion of existing batch applications to online graphic mode, for use in geoseismic modeling, base map generation, mapping and contouring, and selected forms of seismic data analysis.

In the future, it is expected that many new applications will be implemented that greatly expand the interpretive capability of the geologist and geophysicist. Such areas as seismic inversion, migration, well log/seismic trace correlation, seismic stratigraphy, and data integration are all receiving attention and considerable R and D effort.

To implement future systems in these and related areas will require considerable effort in regard to data base and system design, graphic interfaces, and user communications and training.

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Use of Interactive Computer Graphics to Solve Complex Geological Problems—A Case Study

The exact role of the computer in the fields of geology and well log analysis has been the subject of some controversy and a lot of confusion. The computer, when properly implemented and programmed, can assume a different role—that of an analysis partner. In this approach, the user must be able to communicate both freely and naturally with the computer—and vice versa; i.e., the system must be truly interactive. Another key element is graphics, since the geologist's world is usually described using maps, graphs, diagrams, charts, logs, etc. An interactive graphics system has been used to analyze several formations in various parts of the world. The main portion of this paper uses some of these analyses in a "case study" approach to help describe the techniques.

Most of the analyses involve interactive log analysis. The logs were first subjected to a conventional analysis using the computer to help speed up the mathematical computations. The computer also generated all data listings, graphs, plotbacks, and crossplots during this phase.

The next phase was an in-depth detailed analysis to discover more about the key characteristics of the formation. Most of these algorithms are beyond the capability of a handheld calculator, but the interactive nature of the system makes the techniques very easy to use. In addition, several separate models for each well were generated and the results compared statistically in a short span of time.

Results from several formations, including the Mancos "B" in western Colorado, are presented in detail to illustrate the advantage of the use of interactive graphics software. In each formation, an unusual geologic problem was investigated and solved. All formations were determined to be hydrocarbon bearing, and the various zones were identified and analyzed. (The Mancos B is especially interesting in that it is recognized as a tight formation that has resisted some of the more conventional analytic approaches.)

The degree of success achieved in solving these problems indicates that the use of an interactive computer system in this manner is not only valid, but merits more widespread application.

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Petroleum Exploration—Real World Examples Using Microcomputers

Several aspects of petroleum exploration are concerned with numerical values, such as the structural elevation of a given formation, net sand thicknesses, water saturations, or interval velocities. Microcomputers provide an interactive way for a geologist or geophysicist to generate on-demand, exploration related values, maps, or other output.

Geologic examples include the use of best-fit trend surfaces for exploration in the Cretaceous of the Denver basin and the use of double Fourier series to model oil-productive paleotopography in the eastern Powder River basin of Wyoming.

Geophysicists are more accustomed to mathematical treatment of their data. In the Michigan basin exploration area, a microcomputer is being used to generate synthetic seismograms from sonic log data. These are then used to model seismic response for differing stratigraphic conditions. Data from the coastal plain area of Alaska have also been input to a microcomputer which then computes and plots several parameters including time, depth, average velocity, and interval velocity as well as subcropping and onlapping intervals at unconformities.

As a result of their versatility, on-demand accessibility, and relative computing power at a small price, microcomputers are being used in expanding applications in petroleum exploration.

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Computer Modeling of Minnelusa Formation (Pennsylvanian-Permian) Paleotopography in Eastern Powder River Basin, Wyoming

The great majority of Minnelusa Formation (Pennsylvanian-Permian) oil production in the eastern Powder River basin is derived from various types of stratigraphic traps which resulted from paleotopographic relief developed on the upper Minnelusa. This relief is mirrored by thickness variations in the overlying Opeche Shale (Permian). Construction of isopachous maps of the Opeche is one of the methods used to explore for paleotopographic traps in the Minnelusa.

Hand-contoured Opeche isopachous maps may be subject to ambiguous interpretations in areas where the data points are scattered or nonexistent. This difficulty is partially overcome when the isopachous map is produced by mathematical methods.

The upper Minnelusa paleotopography is believed by the author to reflect eolian sand dunes encased by the red shale of the Opeche. Observations from oil tests in the area indicates