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The Use of Microcomputers in Seismic Interpretation

by H. Roice Nelson, Jr.

After all the expense and effort of shooting a seismic survey, processing the data, and interpreting it, finding oil is still a risky business. Even with the best science we can never be sure of prospects. Deciding where to drill is a matter of judgement and, in the end, you take the risk and chance the profits or losses.

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But with the advent of computers in seismic interpretation, you can raise profits and cut losses dramatically. Computer graphics systems help explorationists overcome two of the largest obstacles to successful interpretation--too much data and too little time. And microcomputer-based graphics workstations provide the most cost-effective means of all for handling these problems, because they allow an interpreter to work one-on-one with the data.

Computer-aided analysis of geophysical data is the logical direction for efficiently handling the volumes of data worked with today. As more and more explorationists are beginning to demand three-dimensional (3D) seismic surveys for evaluating complex geologic sequences, it is apparent that paper mass is a large problem with such survey data. The paper handling problem is enormous and requires new methods of storage, manipulation and display. The use of interactive computer graphics for interpretation rather than paper sections appears to be the best available solution to this problem.

Another reason interactive interpretation is becoming an obvious solution for seismic interpreters is that they spend too much of their time doing things like timing sections, posting maps, contouring maps, calculating isochrons, converting time maps to depth maps (isochron maps to isopach maps), migrating contour maps, calculating potential reservoir volumes, doing economic analyses, and in general, "number crunching." With the time shortage explorationists face, it is paramount that new computer technologies be applied to interpretation techniques to improve the quality and quantity of work accomplished per unit time.

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A device that can help seismic interpreters use their time more effectively is the microcomputer. Several explorationists have bought small microcomputers for themselves and have developed personal software packages to aid in different exploration number crunching operations. Given recent advancements in these smaller computers, the ease of linking them to other computers (minicomputers or mainframes), and their lower costs, an increase in the number and sophistication of such systems is certain.

In order to effectively take advantage of computer number-crunching capabilities, the explorationist generally follows several steps during interactive interpretation. After digitally defining the data source location and the data in depth, the data file is processed as required, then displayed. The explorationist then interactively interprets the data file, documenting his progress on paper, and stores his interpretation on tape or disc. Later, he can retrieve his interpretation for presentations.

One particular method of interpretation that will benefit in hte future from the use of microcomputers is seismic stratigraphy. Seismic stratigraphy will aid interpretation of complex geology, particularly by helping effectively identify the right geologic environment for potential hydrocarbon traps. More efficient and thorough seismic stratigraphic analysis will be made possible through softcopy display and the use of interactive computer graphics systems.

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With microcomputers, it's now possible to look at much more data in more detail in less time. Digital movies from a 3D seismic survey allow quick overview of the prospects, pattern recognition of events not seen on a single section, paleogeological changes by animation of data flattened on specified horizons, the study of 3D geological relationships, and the location of artifacts from inadequate processing by removing all motion of non-geologic origin.

By problem solving from a digital data base using a computer graphics system, explorationists can apply many more variables in an effort to solve increasingly more complex geologic problems. Animating digital seismic files allows juxtaposition of sections before and after processing, or sections with different processing parameters (like varying stacking velocities or filters). In addition, digital sections can be zoomed in controlled resolution steps with the graphics hardware, or smoothly zoomed using an interpolation scheme.

Another key enhancement provided by computer graphics systems is color. Color provides another dimension to the data, allowing enhancement of anomalies of special interest. For example, color can be used as a function machine to filter the data, provide a perception of texture with shadows, maximize dynamic range, or enhance detailed attribute analysis. In addition, color allows the superpositioning of data, like a well log or synthetic overlaid on seismic. Areas of interest can be emphasized by modulating a color overlay or outline.

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Other basic manipulations of the data include image addition, subtraction, multiplication, scaling and look-up type corrections. More advanced operations include digital filtering, matrix multiplication, statistics, coordinate transformations, image merging and edge operations.

The critical benefit from these enhancements in speed, size and flexibility of display will be improvements in the quality of interpretation. Interpreters will come to understand subtle characteristics of and problems with the seismic data when they have tools that allow a detailed and rapid analysis with many options.

The trend toward increased research in the field of interactive interpretation has been underway among major oil companies and contractors for several years now, and it is reasonable to project that development of this technology during this decade will be more rapid than that of most other new technologies in exploration geophysics. Just as children have turned off television to play computer video games, explorationists will soon replace their colored pencils with a microcomputer-based graphics workstation.

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(photo 1-A)

(cutline)

Map displays can be presented in map,isometric or perspective views. This is a 1024 x 1280 display.

(photo 1-B)

(cutline)

On an interactive video system, this reflection form has a unique texture which represents shale, coal and granitic basement. Easily visible on a 512 x 512 display, this texture is unavailable from traditional paper sections.