date, 72 maps on the elemental analysis have been run and a similar number will be performed on the mineral data.

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How Good are Regional Coal Reserve Figures? Case Study of Winifrede Coal, Boone County, West Virginia

With the increased interest in coal in recent years has come a demand for accurate reserve figures on a regional basis. The tonnage of coal in the area in question is usually all that is considered. This presents a grossly simplified picture, because accuracy is usually implied which may not exist, and much information is not available. With a better understanding of the nature of the raw data and the interpretation process, better use can be made of reserve figures.

To illustrate the process of producing regional coal-reserve figures, recent work of the West Virginia Geological Survey on the Winifrede coal in Boone County was chosen. First, the types of data were considered both from the viewpoint of method of collection and from the viewpoint of value and accuracy. Next, the geologic interpretations, structure, outcrop, cross section, and isopach, were considered. Then the engineering and mining interpretations, percent parting, cover thickness, proximate analysis, sulfur values, mining height, mined area, and reserves, were determined. Finally, economic considerations were overlaid on the geologic and engineering considerations.

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Computer-Aided Graphics for Analysis of Cottageville Field, Jackson County, West Virginia

It has been said that the purpose of computing is insight, not numbers. In the Cottageville field, Jackson County, West Virginia, computer-aided graphics relate structure and stratigraphy to observed gas production. The Akima bivariate interpolation scheme for irregularly distributed data points provides structure and isopach contour maps or perspective three-dimensional surface displays. NCAR (National Center for Atmospheric Research) graphics software is helpful.

Further insight into the Cottageville field is obtained by use of open-flow and production data from the lower Huron Member of the Ohio Shale. These data are converted to graphics quickly displayed on a cathode-ray tube terminal followed by output on a 36-in. (91.4 cm) matrix plotter or a color-microfilm recorder. This method makes it possible to reject or recheck spurious data points or modify previous computations. Correlation using three-dimensional isometric histograms, gray intensity shading, and color blending is useful.

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Fabric-Element-Based Classification for Low-Porosity-Shale Gas Reservoirs

Several hundred shale samples have been characterized by us with respect to mineralogic composition, chemical composition, and petrophysical properties. However, no study based on composition reveals the fabric or manner in which the components are put together to form the resultant rock. Classification by fabric elements, based on X-radiography and direct prints from thin sections, is practical and appears useful for interpretation of both depositional environments and reservoir properties of shale.

Six lithotypes based on fabric elements are defined in Devonian shales of West Virginia: (1) sharply banded shale, (2) thinly laminated shale, (3) lenticularly laminated shale, (4) nonbanded shale, (5) siltstones, and (6) concretions. A gradational series exists from thinly laminated through lenticularly laminated to nonbedded. Thinly laminated and organic-rich lenticularly laminated shales appear the most favorable types for gas productivity because the laminated fabric permits the best lateral continuity of the low porosity (about 2%) present. The higher organic content of these lithotypes also probably acts as sites for significant sorption of gas, which is slowly released during production.

No microfracture system appears to exist, and macroscopic fractures do not necessarily coincide with productive zones. Wells without natural fractures prove productive after stimulation, which suggests that outgassing of a favorable rock type is responsible for the bulk of productive gas in Devonian shale wells. Natural fracture porosity, while important in extending effective volume tapped by a given well, represents only a minor portion of reservoir storage volume.

Thinly laminated shales are interpreted as being generally representative of shallow-marine deposits (dominantly shelf deposits) accumulating under anoxic conditions. Nonbanded and lenticularly laminated shales are deeper water accumulations deposited farther from shore. Sharply banded shales and some siltstones generally represent pulses of more rapid sedimentation in the prodelta environment. A single sample in itself is not diagnostic of depositional environment, but relative abundance of specific lithotypes in a given vertical section is useful for general environmental reconstruction. Better definition of the diagnostic worth of shale fabric-element lithotypes awaits results of more detailed fabric-element studies of modern fine-grained clastics and marine muds.

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Patch Reefs and Interreef Deposits of Silurian McKenzie Formation, West Virginia

Coral-stromatoporoid patch reefs are present in the lower part of the McKenzie Formation of the western West Virginia subsurface. Between these organic buildups is a bedded, argillaceous dolomite with very sparse fauna, and underlying the McKenzie is the Keefer Sandstone which served as the firm substrate on which McKenzie benthic communities became established.