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MORGANTOWN ENERGY TECHNOLOGY CENTER

**ISOPACH MAP OF
HIGHLY RADIOACTIVE BLACK SHALE
IN THE CHATTANOOGA SHALE OF
SOUTH-CENTRAL KENTUCKY**

By S. B. Dillman and F. R. Effensohn

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DISCUSSION

Radioactivity in green shales reflects radioactive potassium associated with the dominant clay fraction (Ettensohn and others, 1970). Nevertheless, the small size and number of green shales and their generally known stratigraphic occurrences (in Units 2, 3, 4, 5, 6; see Swager, 1978, and Ettensohn and others, 1979) suggest that their possible radioactive input is insignificant and predictable.

These radioactive isopach maps are based on approximately 600 gamma ray logs available at the time of study from the 43 county area comprising eastern Kentucky. In the Five Mountain area few logs were available, and in those logs available, parts of the section were commonly repeated as a result of faulting (Weaver and others, 1978). Hence, in this series of maps, isopach contours are not drawn on the Five Mountain Thrust Block. The isopach contour intervals are largely based on the radioactive stratigraphic units of Provo (1977), who was able to distinguish seven persistent subsurface units by their distinctive signatures on gamma-ray logs (see accompanying log and stratigraphic chart). The same units were then found and correlated along the east-central Kentucky outcrop belt by Swager (1978), using a scintillometer scale described by Ettensohn and others (1979). Correlations between these units in Ohio, New York, Pennsylvania, West Virginia and Virginia were suggested in stratigraphic cross sections by Kapler and others (1978). Reen and others (1978) and Wallace and others (1978), Units 2, 3, 4, and 5, are combined on one map, whereas units 6 and 7 are subdivided into the base and West Fork formations for scale in correlation with present states. Isopach maps for each of these units (E.G.S.P. Series Nos. 515-522) and structure contour maps drawn on the basis of each unit (E.G.S.P. Series Nos. 503-514) in eastern Kentucky (Dillman and Ettensohn, 1980a, b) are available from the Department of Energy, Morgantown Energy Technology Center.

This map is one of a series of five radioactive isopach maps (E.G.S.P. Series No. 502-506) showing the thickness of highly radioactive black shales in each of four radioactive units in eastern Kentucky, and in the Chattanooga Shale of south-central Kentucky. The isopach interval on each map is indicated by arrows on the accompanying log-stratigraphic chart. Because the individual units undergo pronounced thinning on the Cincinnati Arch in south-central Kentucky, they are commonly too thin to be recognized or accurately measured, and are treated together as the Chattanooga Shale on E.G.S.P. Series No. 502.

On these isopach maps, highly radioactive shale included any thickness of shale with a positive gamma ray deviation greater than 20 API above the shale base line. An average green shale from the Three Lick Bed (Unit 6 of Provo and others (1978) was used to draw the shale base line (see example map); except for the Chattanooga Shale, in which the Three Lick Bed was not always easily recognized. In this case, a shale base line will be offset further to the lower end of the API scale and may allow the inclusion of some shales less radioactive than those isopach on succeeding maps in the series. The Borden shale base line is generally not as sensitive in separating moderately radioactive shale from highly radioactive shale and is probably not as good of choice as the Three Lick base line where the Three Lick Bed is discernible. Besides the obvious problems inherent in different base line and in different recording equipment, Schwake (1980) commented on two other problems which must be considered when using this method to define organic-rich basins: 1) the gamma-ray intensity of the shale base line may vary regionally throughout the basin, and 2) change in gamma-ray intensity per unit change in organic content will also vary regionally throughout the basin. Additional discussion on the procedures and problems involved in using this method can be found in studies by Dillman (1980) and Schwake (1980). Similar radioactive isopach maps for the black shales of New York have been produced by Van Type and others (1980).

The faults on the map are all surface faults and were taken from the Oil and Gas Map of Kentucky (Willson and others, 1979, 1978). The axis of the Cincinnati Arch was taken from Allison (1931) who used data from Ordovician rocks to determine its position. Thicker than normal accumulations of highly radioactive black shale show some relationship with structural trends. Thick accumulations are seen along parts of the Rome Trough, the Floyd Cyncline, a probable southern end of the Rome Trough (Ammon and Kaller, 1979), and along unmetamorphosed T1 structures in Pike and Greenup counties (see Dillman, 1980).

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SAMPLE LOG SHOWING RADIOACTIVITY BASELINE

Thicknesses of black shale above the 20 API baseline (shaded on diagram) were isopach.

SAMPLE LOG-STRATIGRAPHIC CHART

6.1. = Contoured Interval

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