

Using the National Coal Resource Data System to Assist
Coal Resource Investigations in Indiana

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Coal is present in the Pennsylvanian rocks of west-central and southwestern Indiana. This area is part of the province known as the Illinois Basin (Figure 1).

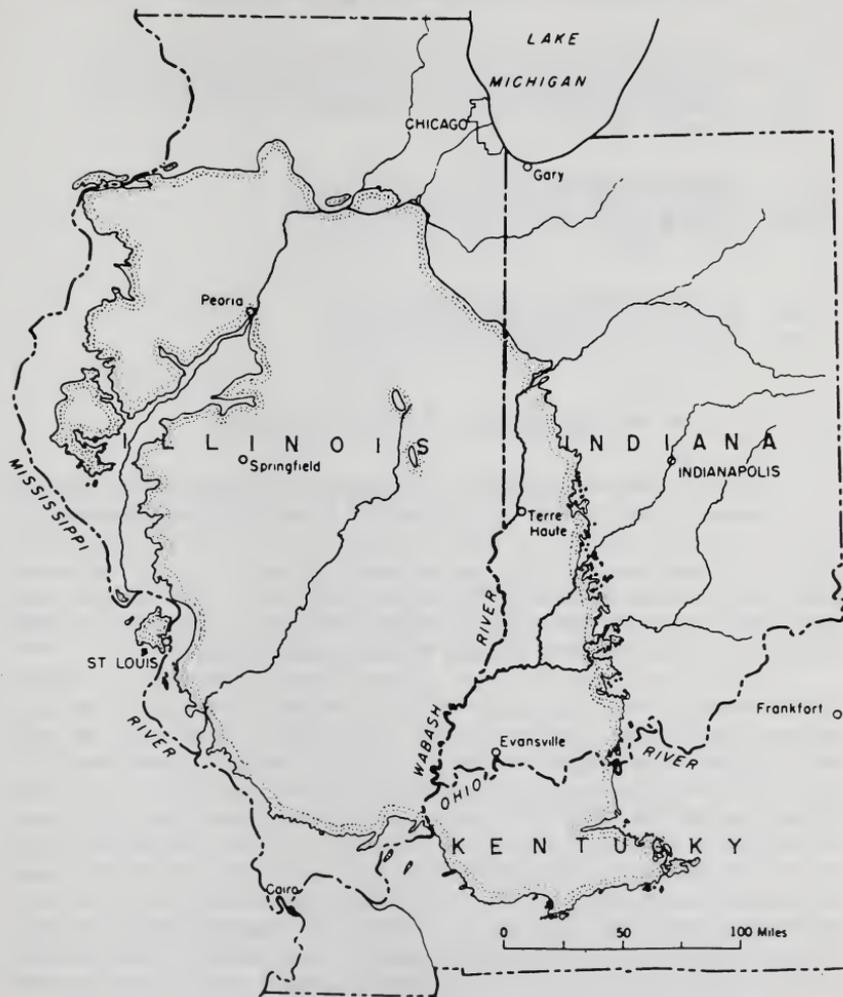


FIGURE 1. Map of the Illinois Basin (modified from Spencer (1)).

Numerous estimates of Indiana's coal resources have been compiled since coal mining began in the state in the early 19th century (Figure 2). These estimates were assembled by various methods and laboriously calculated by hand.

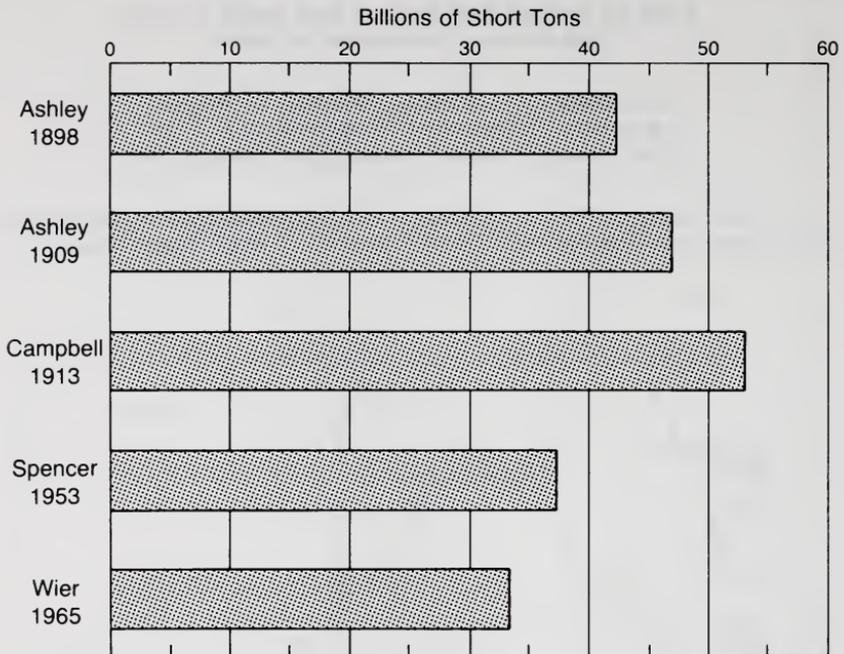


FIGURE 2. Graph showing coal resource estimates for Indiana.

The first comprehensive estimate of coal resources in Indiana was calculated by G. H. Ashley in 1898. He used a simple method of multiplying the estimated areal extent of a coalbed (acres) by the estimated thickness (feet) and then multiplying the product by a factor intended to represent the weight (tonnage) of coal per unit volume (acre-foot). Workable coal-tonnage figures were calculated by multiplying the total seam weight by a factor of 0.5 (50 percent), which represented an estimate of the amount of coal that could be extracted by underground mining.

In 1909 Ashley revised his earlier estimates to include additional mine and exploratory data (1). Four years later, M. R. Campbell (1913) further modified Ashley's estimates by assuming a greater tonnage per acre-foot (1). In the subsequent 40 years, surface mining slowly replaced underground mining as the predominant method of extraction. During these years increased private and public drilling developed an abundance of coal data. In 1953 F. D. Spencer employed this new information to recalculate the estimates of coal resources according to the standardized U.S. Geological Survey (USGS)-U.S. Bureau of Mines (USBM) classification system. The USGS-USBM system (Figure 3) includes measured, indicated, and inferred coal resource estimate categories, each of which reflects the geologic assurance that economically recoverable coal exists in that category (2). Measured estimates consist of coal within a quarter of a mile radius from the point of thickness measurement, indicated estimates consist of coal from one-quarter to three-quarters mile, and inferred estimates consist of coal from three-quarters mile to 3 miles.

In 1965 C. E. Wier used revised interpretation of Spencer's coalbed correlations and knowledge gained from newly collected and compiled coal data to produce new estimates of measured coal resources. This investigation was the most recent attempt to estimate coal resources in Indiana.

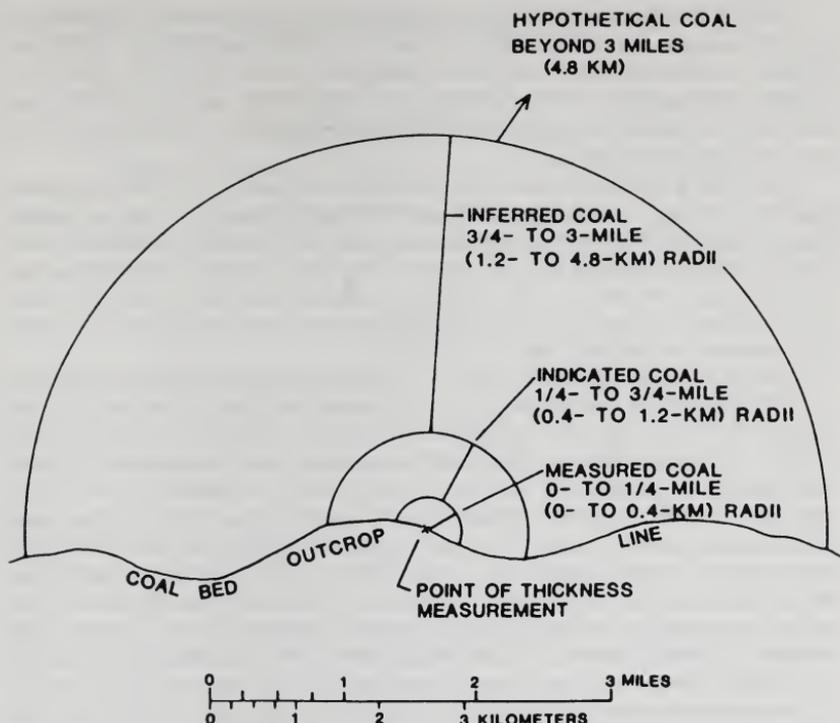


FIGURE 3. Diagram showing resource categories based on distance from the point of measurement (modified from Wood and others (2)).

Since Wier's study the Indiana Geological Survey (IGS) has continued to collect coal data. Types of data currently available at the IGS include coal-mine maps, geologic work maps, published coal maps, miscellaneous coal publications, IGS coal chemical analyses, and coal-drilling logs.

Because data on Indiana coal resources are expanding, frequent review and refinement of geologic interpretations and resource estimates are necessary. A data-management system is required to facilitate new interpretations and evaluations of this expanding data resource. The digital computer is an ideal tool for this kind of work.

The National Coal Resources Data System (NCRDS) was developed by the USGS and the USBM in the early 1970s to assess the quantity and quality of coal resources of the United States by using the standardized classification system. NCRDS is a computerized storage, retrieval, and display system designed to analyze coal data collected from federal and state agencies, universities, and the private sector. As a computerized system, NCRDS readily accommodates an expanding data base and subsequent geologic interpretations to serve current and future coal-resource inventories and analyses.

The USGS is responsible for investigating the coal resources for the 38 coal-bearing states. To meet this national responsibility, the USGS has initiated coal resource assessment programs in cooperation with state agencies. In 1975 the IGS entered into a 1-year cooperative agreement with the USGS to collect coal samples for chemical analysis, and in 1982 it began a 5-year cooperative agreement to enter coal data from the IGS files into the NCRDS.

Several data bases are available to NCRDS users. They include published coal-resource estimates for the coal-bearing states (USCOAL, BMRESBAS), USGS and USBM chemical analyses of domestic and foreign coal samples (USALYT, BMALYT, ICHM), petrographic analyses (USPET), and stratigraphic data (USTRAT). These data can be tabulated or merged with coal-extent information and then plotted and contoured for isoline maps.

This IGS is currently entering coal-thickness information into the stratigraphic data base. The data is coded on standardized USGS stratigraphic-entry forms and plotted along with the coal boundaries and mined-out areas of 7.5 minute quadrangle maps. These data are then entered into the computer for analysis. Coal-thickness values and stratigraphic information are typed into the stratigraphic data base (USTRAT). Data-point locations, coal-extent information, and mined-out areas are digitized, processed, and submitted on magnetic tape to the USGS.

Coal-resource estimates are made by the IGS by using programs developed for NCRDS. First, the data points are given the digitized data point location coordinates. Next, the USTRAT data base is searched by using the program PACER to retrieve a subset of data points relevant to the area and coalbed under consideration. Finally, coal resources are calculated by using the program GARNET. GARNET uses an evenly spaced grid of thickness values produced by the computer to contour the isopach map of the coalbed and to compute resources. Original coal resources are computed by terminating the resource calculations at the outcrop, subcrop, or lateral stratigraphic extent. Remaining coal resources are computed by terminating the calculations at the surface- and underground-mine boundaries as well as at the coal-extent boundary. Coal resources can be calculated for specific thickness or over-burden categories by restricting the computations to the area between contours of the thickness or overburden map.

The products of the analysis include a valuable set of work maps that represent a consolidation of all the coal thickness and extent information available at the IGS as well as tables of original and remaining coal-resource tonnages. Computer-generated contour maps, such as isopach maps and structure maps, can be used to aid the geologist with interpretations or to present final results. Coal-resource maps are generated to show the areas included in resource calculations. Other products of the computer analysis include stratigraphic cross sections consisting of columnar sections and three-dimensional displays. Besides resource-tonnage tables and computer-generated maps, the system is capable of computing various statistical parameters that include the minimum, maximum, mean, sum, variance, standard deviation, slope, intercept, and correlation coefficient.

The IGS is using NCRDS to prepare summaries of coal resources and quality for each of the counties in the Indiana coalfield. The system will also be used to refine the estimates of designated areas or to delineate areas that have specific coal thickness or quality characteristics.

Literature Cited

1. Spencer, F. D., 1953. Coal resources of Indiana: U.S. Geol. Survey Circ. 266, p. 12.
2. Wood, G. H., T. M. Kehn, M. D. Carter, and W. C. Culbertson, 1983. Coal resource classification system of the U.S. Geological Survey: U.S. Geol. Survey Circ. 891, p. 2.