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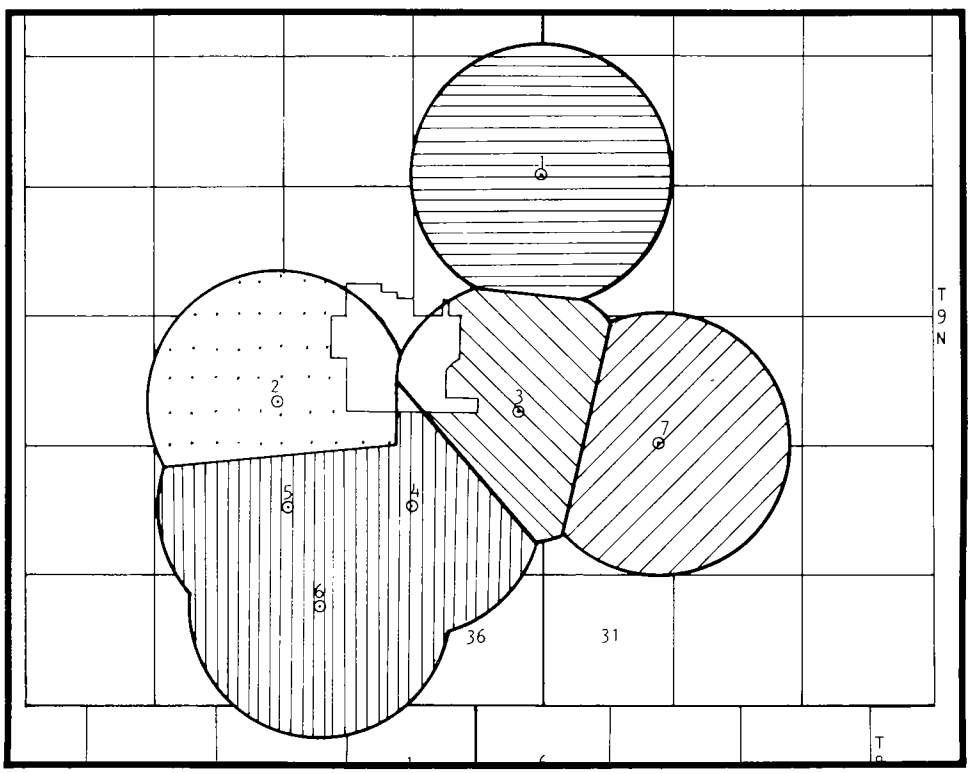
Determination of Reserves of Methane from Coal Beds for Use in Rural Communities in Eastern Oklahoma

Samuel A. Friedman



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DETERMINATION OF RESERVES OF METHANE FROM COAL BEDS FOR USE IN RURAL COMMUNITIES IN EASTERN OKLAHOMA

Prepared by

Samuel A. Friedman

Oklahoma Geological Survey
The University of Oklahoma
Norman, Oklahoma

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DISCLAIMER

DETERMINATION OF RESERVES OF METHANE FROM COAL BEDS

FOR USE IN RURAL COMMUNITIES IN EASTERN OKLAHOMA

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DETERMINATION OF RESERVES OF METHANE FROM COAL BEDS FOR USE IN RURAL COMMUNITIES IN EASTERN OKLAHOMA

Samuel A. Friedman

I. ABSTRACT

Coal-bed methane has been classified as an unconventional source of gas by the United States Congress, and it has no Federal price limit. Thus, it is attracting considerable interest concerning its reserves, potential recovery, and use.

Previous work in Oklahoma showed that approximately 1.3 trillion cubic feet of identified coal-bed-methane resources is present in Haskell and Le Flore Counties. Thus the present study was undertaken to determine the feasibility of using methane from coal beds in rural areas in eastern Oklahoma, and to recommend general locations in which to drill from 500 to 1,800 feet deep to selected coal beds for methane production.

Coal-bed-methane reserves have been identified in the Hartshorne coals (Desmoinesian) in the vicinities of Spiro and Poteau in Le Flore County and of Keota in Haskell County, all in the Arkoma Basin. These areas are recommended for exploratory drilling and production of coal-bed methane, because they meet criteria of depth (500-1,800 feet) and potential rural use by the municipal governments or small rural businesses.

A minimum of approximately 33 billion cubic feet of coal-bed-methane reserves are estimated, by standard procedures, to be recoverable in the three recommended areas.

II. INTRODUCTION

A. Purpose.

The purpose of this study is to determine the feasibility of using methane that is extractable from coal beds in rural areas in Oklahoma, and to suggest a site on which to drill into the coal and to produce the methane. This study could lead to the development of coal beds in Oklahoma as an unconventional source of natural gas for rural users.

Methane extracted from coal beds is used like conventional natural gas and can be collected through normal well-drilling procedures. Rural and small community users of the potential production of coal-bed methane could be electric cooperatives, small industries, city halls, schools, and hospitals.

This project is designed to (1) determine quantities and the favorable location of identified coal-bed-methane reserves, and to (2) stimulate interest in coal-bed-methane use and to provide an alternate energy source for rural and small communities.

B. Scope.

The data sources in this study are existing drillers' logs and other borehole logs and records, showing depth and thickness of coal beds in Haskell, Latimer, Le Flore, and Pittsburg Counties.

Most of these logs are private, confidential, and proprietary. Approximate depths at which the methane and coal beds are present

are 500 to 1,800 feet. In Oklahoma these are very shallow depths for a gas well, but they are typical depths for reserves of bituminous coal in the area of the four counties in the study area. The reason there was no drilling-cost analysis is because of insufficient time as the deadline approached for submitting the final draft of this report. The writer believes that determining drilling costs is not as important as demonstrating to the public just where and to what extent coal-bed methane reserves can be recovered as determined by the most reliable geological methods. Furthermore, private investment capital for drilling for and producing coal-bed methane most likely will be available under the free-market, profit-motif system. The writer believes that if development is inhibited by governmental regulations or economic policy, then private capital will not be available for coal-bed methane development.

C. Criteria

The majority of the confidential drillers' logs of coal-test boreholes that the coal exploration and mining industry made available for this study attain depths of 500-1,800 feet. Thus this depth interval is used as the depth criteria for coal-bed reserves and for methane reserves.

A maximum coal-bed thickness is not established, but the minimum is 2.0 feet.

Criteria for coal resources and reserves determination and terminology follow those of the U.S. Geological Survey as modified for use in Oklahoma (Friedman, 1974). The "demonstrated" category was applied in the present study in evaluating the estimated

resources and reserves of both the coal and the methane that is inherent in the coal.

Only identified coal resources and reserves based on coal-test borehole data are used in this study to determine the methane content in the coal bed. Desorption tests on new coal samples were not available, and thus the computation formula method, developed by the U.S. Bureau of Mines, was used to estimate methane resources. The formula is based on range in depth of the coal, the specific gravity of the coal, and the thickness of the coal (McCulloch and others, 1975; Iannacchione and Puglio, 1979a). This method proved to be superior in estimating methane resources in the Hartshorne coal in the favorable areas recommended for drilling in the present report.

The presence of identified coal resources based on coal-test logs was the most important criterion in selecting the three areas that are recommended for exploratory drilling, extraction, and production of methane from coal.

The second most important criterion applied was a positive attitude of the leaders of the rural communities towards development of the methane.

Any well sites should be within 5 miles of a rural community to keep the gas transportation cost at a reasonable level.

D. Previous Work

The occurrence of natural gas in coal has long been known. Seldon (1934) described this gas in detail. Subsequently Stach and other (1975, p. 329) discussed and reviewed the origin in coal

of methane and other gases during coalification (or coal metamorphism). Kim (1974) noted the organic composition and sequential evolution of gas in coal beds. Cervick (1969) discussed gas that originated in coal and then formed reservoirs. Airey (1968) experimented with gas emissions from broken coal.

Irani and others (1972) documented gas volumes being vented from underground coal mines. Among these was the Howe No. 1 in Le Flore County, Oklahoma. Although this mine was closed in November, 1971, it yielded an average of 1.6 million cubic feet of methane in 24 hours from the Lower Hartshorne coal that averaged 39 inches thick and 350 feet deep. The U.S. Bureau of Mines drilled 5 boreholes in the Lower Hartshorne coal in the Howe, Oklahoma, area to determine gas composition, volume of gas in coal, rate of extraction, and as an experiment in coal-bed-methane-extraction technology (C. H. Elder, 1974, oral communication).

Methane has been extracted from sizable areas of the 4-foot-thick, medium-volatile Hartshorne coal at depths of 1,200-1,400 feet in the area of the Choctaw Mine and vicinity in Haskell County, Oklahoma (Kerr-McGee Coal Corp., unpublished Choctaw Mine report, 1980). In the mine, gas emission is reported to have reached 400,000 cubic feet a day.

Iannacchione and Puglio (1979a) demonstrated in Haskell and Le Flore Counties, Oklahoma, that methane content of the Hartshorne coals is a function of coal depth and rank and that methane emissions in coal mines are controlled by porosity, fracture permeability, and gas pressure, all in the coal bed. Cleat fractures generally

impact on the directional permeability characteristics of coal beds, they concluded. These authors estimated that 58 percent of the methane in the Hartshorne coals, in the two counties studied, is present at depths of 500-1,000 feet.

Iannacchione and Puglio (1979a, p. 13) further stated that a maximum of 1.5 trillion cubic feet of gas resources (methane) is present in 3.2 billion short tons of the Hartshorne coal in Haskell and Le Flore Counties, Oklahoma.

Their published conclusions were derived in part from unpublished extensive coal-resource data provided by the present writer under a cooperative agreement between the U.S. Bureau of Mines and the Oklahoma Geological Survey.

Rieke (1980, p. 5-1) stated that 16 Hartshorne coal samples from Haskell and Le Flore Counties have been desorbed by the U.S. Bureau of Mines. The composition and rate of flow of the gas has been reported (Kerr-McGee Report, 1980, and Iannacchione and Puglio, 1979b). In 1980, the TRW Company, using DOE funding, obtained methane desorption tests from an unnamed coal whose rank is high-volatile bituminous A. This coal is about 1 foot thick in the Barringer well No. 1-11, sec. 11, T. 4 N., R. 15 E., Pittsburg County, Oklahoma. The desorption test run by the U.S. Bureau of Mines showed that the coal, penetrated at 3,640-41 feet deep, yielded 7.3 cubic centimeters per gram (234 cubic feet per ton) of methane.

E. Acknowledgments

The writer acknowledges the cooperation of the United States Department of Energy (DOE), Dallas Regional Office, for which

this report was prepared. Conversations and correspondence with John Conway, DOE Technical Project Coordinator, were especially helpful. Kerr-McGee Coal Co. and Garland Coal & Mining Co. cooperated by providing valuable drillers' logs of coal-test boreholes. Karl M. Hartman, geology major at The University of Oklahoma, assisted in the preparation of the table and the maps of the coal-bed-methane resources.

The intellectual inspiration for this work is derived from the pioneer activist in American coal-bed-methane studies--Maurice Deul of the United States Bureau of Mines.

III. BACKGROUND

A. Geography

McAlester, the county seat of Pittsburg County, is the largest city in the Arkoma Basin part of the coal field, and it contains approximately 18,000 people. Poteau is the seat of Le Flore County's rural government, and it contains about 5,500 people. Other coal-field cities and towns are much smaller in population than these. For example, the populations of Stigler, the seat of Haskell County, is 2,400, and of Wilburton, 2,504; Spiro, 2,000; Howe, 400; Bokoshe, 588; Keota, 685; Red Oak, 609; and McCurtain, 575 (U.S. Census [1970] as published on the 1980 Official Highway Map of Oklahoma).

Transportation is facilitated through the Arkoma Basin part of the coal field by the presence of major highways such as Interstate 40, the Indian Nations Turnpike, and U.S. Highway 69. Other well-used routes are State Highways 2, 9, 31, 270, and U.S. Highway

59. Railways serving this part of Oklahoma are the Rock Island, the St. Louis-San Francisco, the MK&T (the Katy), and the Kansas City-Southern. Muskogee and vicinity is a rail center, and Poteau and vicinity is a smaller rail hub.

Vast quantities of water are present in Lake Eufaula and Robert S. Kerr Reservoir, which are located on the north side of the Arkoma Basin area.

The southern part of the Oklahoma coal region is in the Arkansas Valley section of the Interior Highland physiographic province (Fenneman, 1931). Part of this province has been divided into the Arkansas Hill and Valley belt and the McAlester Marginal Hills belt (Johnson and others, 1972, p. 3). The Arkansas Hill and Valley belt contains broad, gently rolling plains and valleys and scattered hills that are 100 to 300 feet high.

The McAlester Marginal Hills belt contains broad hills, some of which are 300 feet high, and mountains, a few of which attain 2,000 feet above wide hilly plains.

B. Geology

The specific rural areas selected for coal-bed-methane-gas production are in Haskell and Le Flore Counties, which are in the eastern part of the Arkoma Basin in Oklahoma (fig. 1). The major part of the stratigraphic section that must be penetrated by drilling and that overlies the Hartshorne coals is in the McAlester Formation of the Krebs Group, Desmoinesian Series, which is part of the Pennsylvanian System of rocks (fig. 2). These strata are approximately 900 to 1,600 feet thick in the areas that are here recommended for coal-bed-methane production.

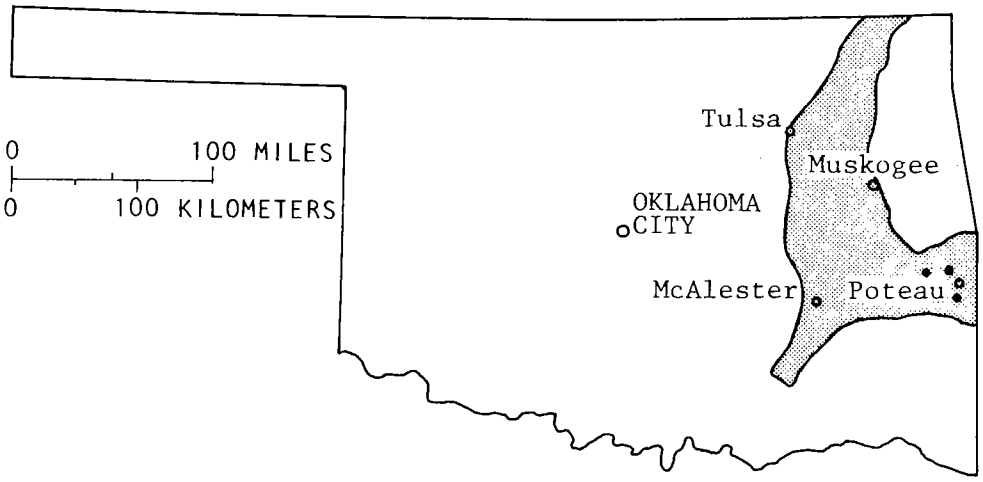


Figure 1. Index map of Oklahoma showing location of coal-field area (stippling), containing recommended sites (dots) for coal-bed-methane development.

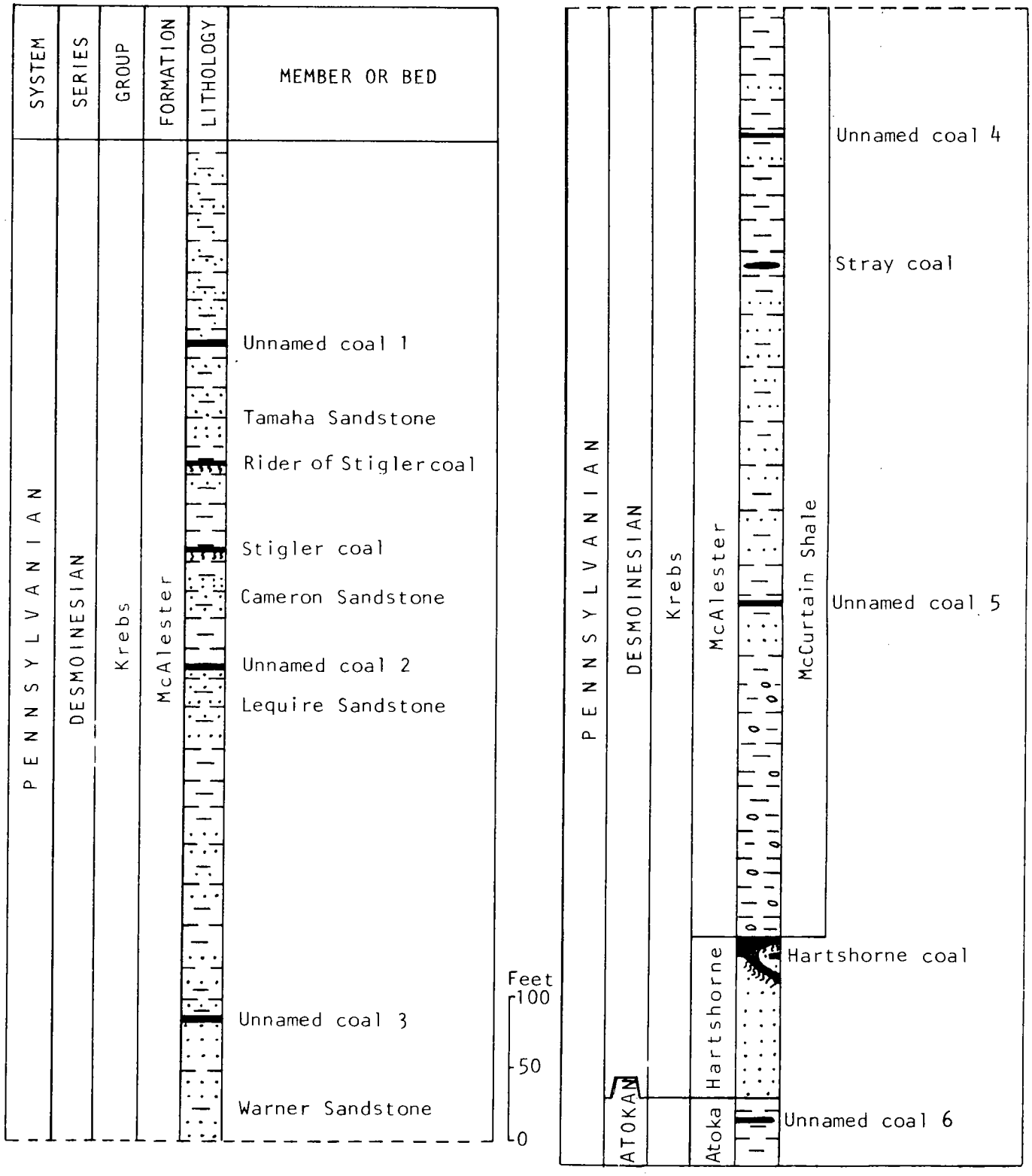


Figure 2. Generalized stratigraphic section for Arkoma Basin.

The Hartshorne coals that have been evaluated for methane resources are at the base of a thick, clastic stratigraphic sequence that contains the identified coal resources. This sequence, in ascending order, consists of the Hartshorne, McAlester, Savanna, and Boggy Formations, which are about 6,000 feet thick in the San Bois and Cavanal Mountains of Haskell, Latimer, and Le Flore Counties, respectively. These formations are essentially clastic rocks, composed of sandstone, siltstone, shale, and mudstone. Calcareous shale, coal, and underclaystone are present in smaller amounts.

Structurally the eastern part of the Arkoma Basin contains these formations and lithologies folded into eastward- and northeastward-trending narrow anticlines and open synclines.

Normal and thrust faults, approximately parallel to fold axes, displace some of the strata up to a few hundred feet at and close to the surface. Thus in some places the faults displace the coal beds, interrupting the continuity of past and present coal-mining operations (Hendricks, 1939; Knechtel, 1949; and Oakes and Knechtel, 1948).

The Hartshorne coal contains a thin claystone parting. In places where the parting exceeds one foot thick, the coal is divided into the Upper and the Lower Hartshorne coals.

In a few places in Le Flore County a channel-fill sandstone of alluvial-deltaic-plain origin fills most of a large interval between the Upper and the Lower Hartshorne coals. The maximum documented interval is 120 feet (Friedman, 1978). Methane is present in both the sandstone and the coals.

Two cross sections illustrate accurately the strata to be penetrated by boreholes to reach the Lower Hartshorne coal in Haskell and Le Flore Counties, Oklahoma. Specifically figure 3 represents the area in the vicinity of Keota, and figure 4, Spiro and vicinity. These are standard stratigraphic cross sections and are self explanatory. Each column in the cross sections is derived from a confidential driller's log of a coal-test borehole, drilled for coal exploration. A core of the Lower Hartshorne coal was recovered from each borehole, and measurements were made of the thicknesses of the coal and any claystone or shale partings in the coal. Confirmation of thickness and depth of the coal are vital in accurate determination of coal and methane resources.

C. Coal-bed Methane Economics

The quantity of high-Btu (900-1,000+) methane gas (CH_4) that is produced from conventional-gas wells (8,000-10,000 feet deep) in Haskell or Le Flore County, Oklahoma, is many times greater than the potential production from a shallow (500-1,500 feet deep) well in coal-bed methane. The cost of gas exploration and development and the sale price of methane have increased so rapidly and tend to be so variable that numbers assigned to these economic factors are insignificant in this discussion. Suffice it to state that coal-bed methane is now sufficiently valuable that one or two producing wells could supply certain minimal rural community needs such as heating public schools and other buildings. This methane could also be used in any private building or small industry, or it could be a fuel for irrigation equipment. A successful, producing well-field for

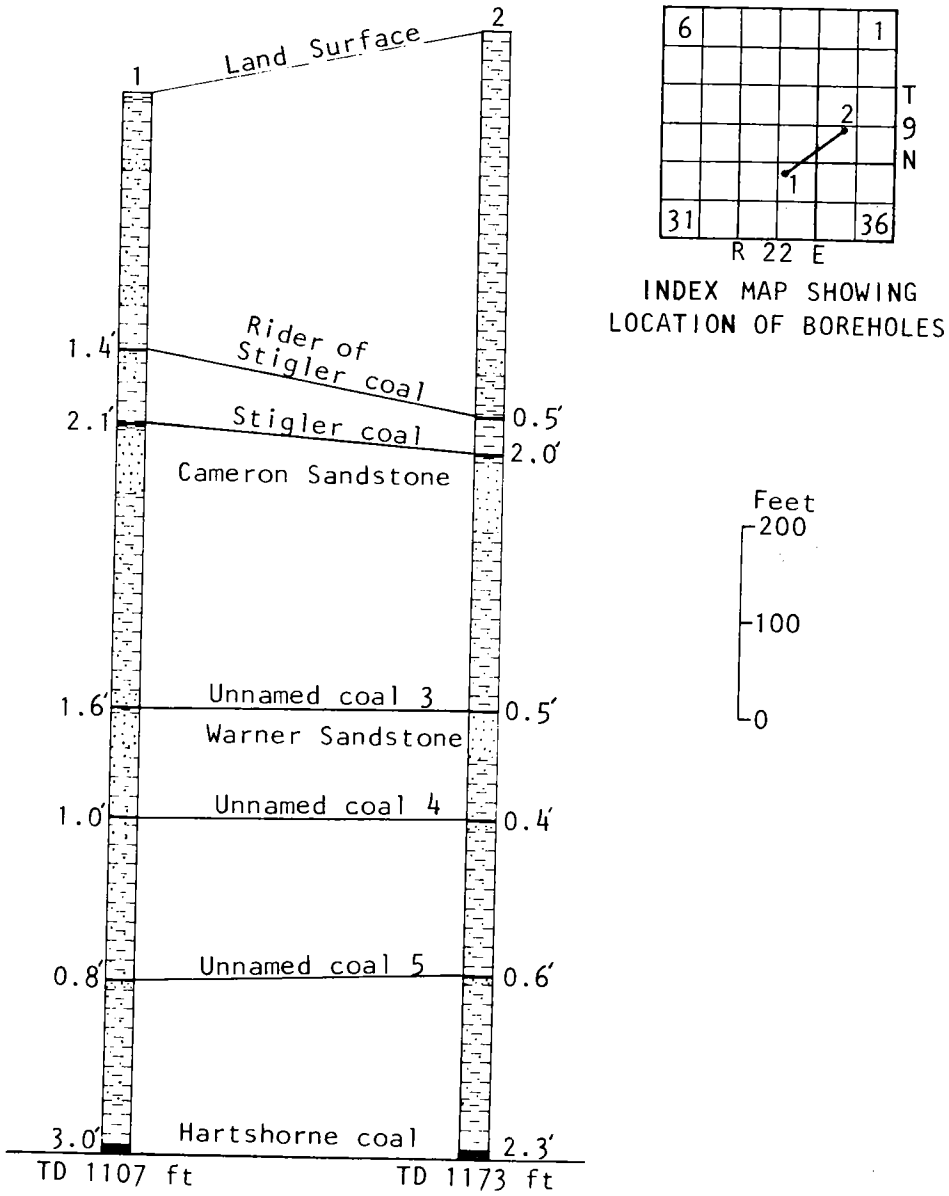


Figure 3. Stratigraphic cross section showing coal depths, correlation, and thicknesses in vicinity of Keota, Haskell County, Oklahoma.

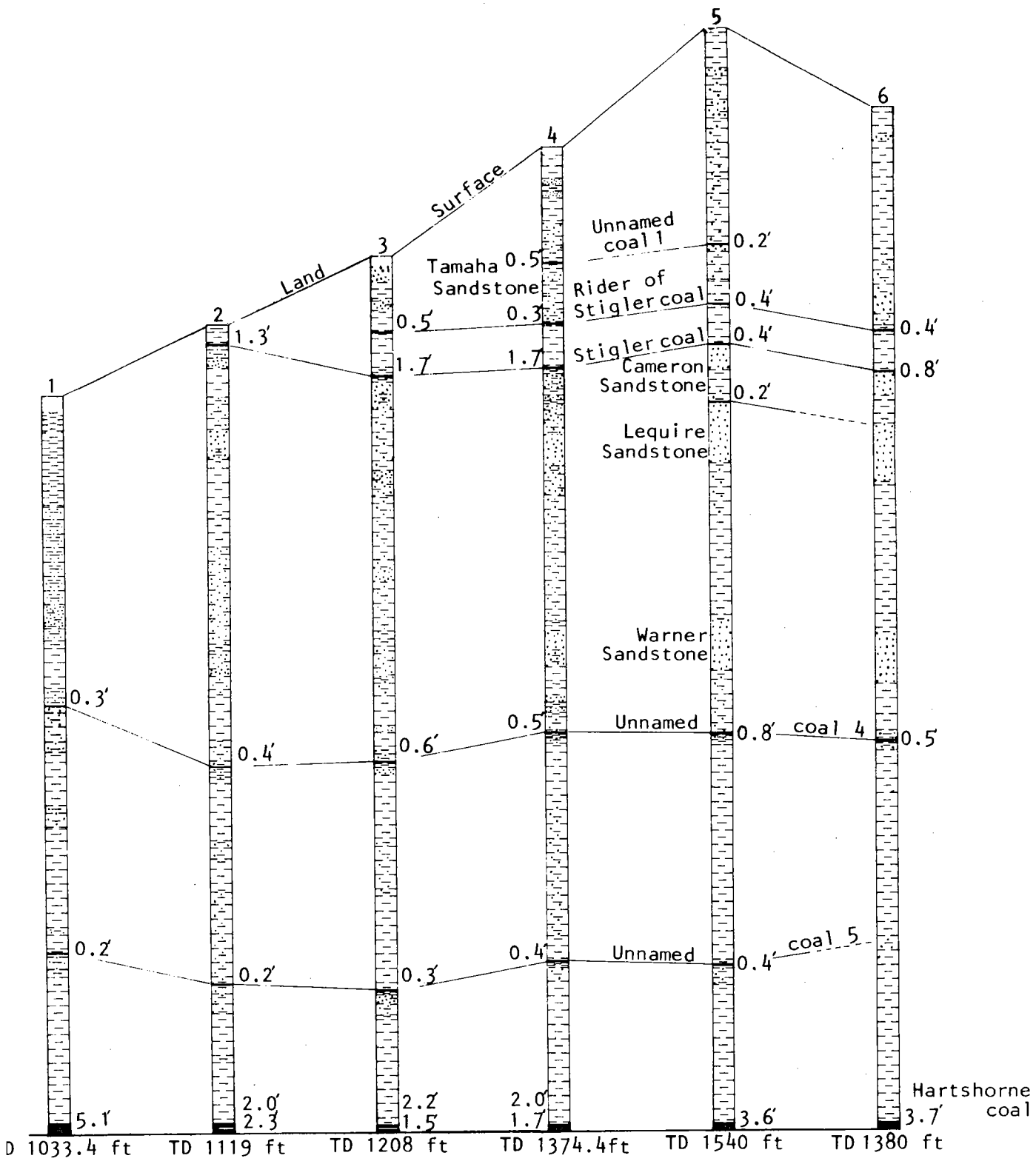
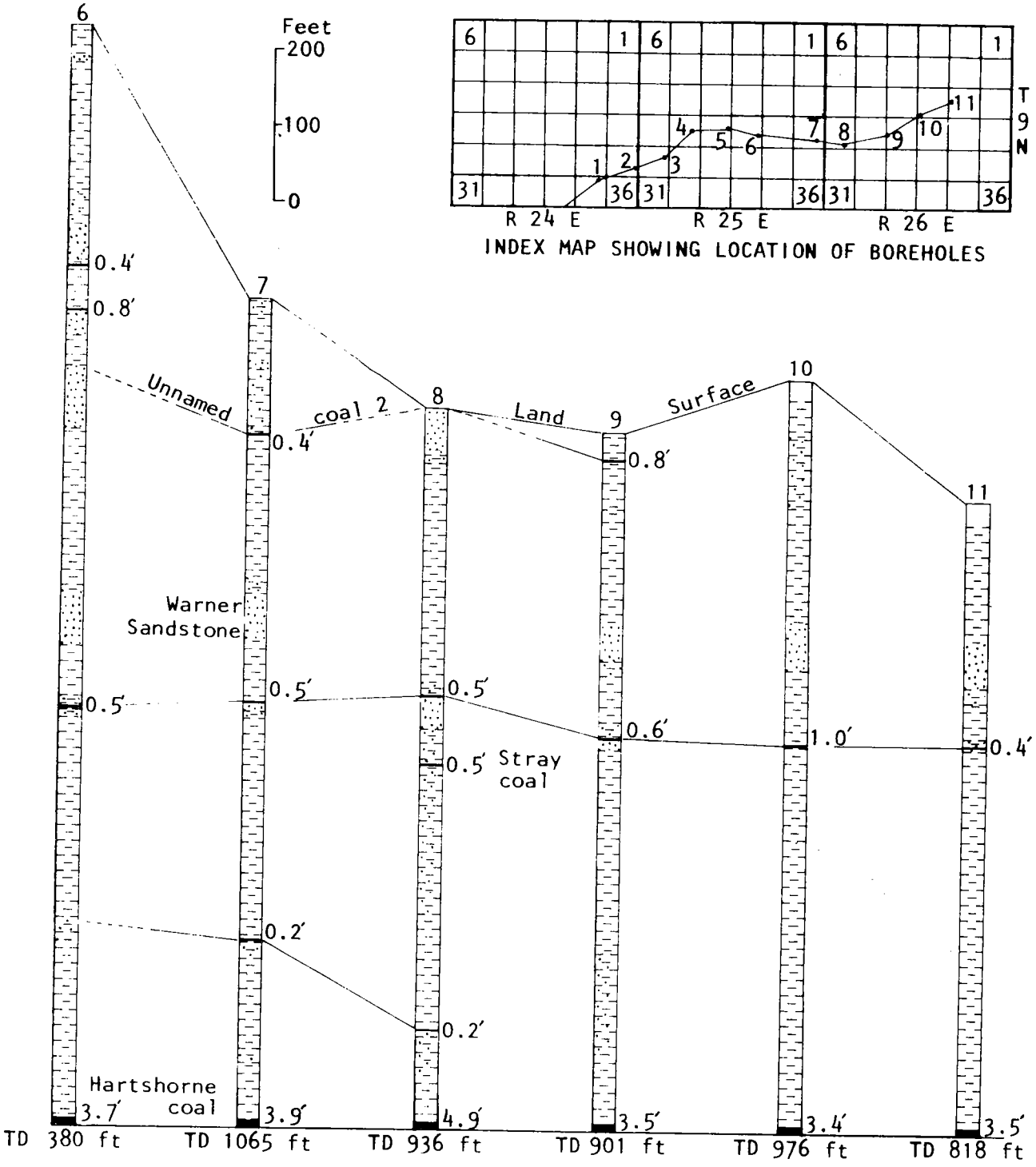


Figure 4. Stratigraphic cross section showing coal depths, correlation, and thicknesses in vicinity of Spiro, Le Flore County, Oklahoma.


6
Feet
200
100
0
0.4′
0.8′
Unnamed coal 2
7
0.4′
8
Land
9
Surface
10
0.8′
11
Warner Sandstone
0.5′
0.5′
0.5′
0.6′
1.0′
0.4′
0.5′ Stray coal
0.2′
0.2′
Hartshorne coal
3.7′
3.9′
4.9′
3.5′
3.4′
3.5′
TD 380 ft
TD 1065 ft
TD 936 ft
TD 901 ft
TD 976 ft
TD 818 ft
R 24 E
R 25 E
R 26 E
T 9 N
INDEX MAP SHOWING LOCATION OF BOREHOLES

coal-bed methane could supply a large part of the rural needs for gas energy.

Coal-bed methane is in use in a few places in the eastern United States. For example, at a Bethlehem Mines Corp. underground mine near Washington, Pennsylvania, 240,000 cubic feet per day of coal-bed methane is used in generating 400 kilowatts of electricity (Chemical and Engineering News, Sept. 22, 1980, p. 17). The electricity is used at the mine.

Government agencies and private consultants have given the present writer proprietary information indicating that coal-bed methane has been and is being produced by use of conventional drilling and recovery techniques from multiple wells and multiple coal beds at the rates exceeding 100,000 cubic feet per day. Thus the present writer concludes that coal-bed methane can be produced at present as a valuable alternate source of energy that competes with other standard energy sources.

A further economic incentive is the fact that the U.S. Congress in 1978 deregulated the selling price for production of coal-bed methane.

D. Coal-bed Methane, Politics, and the Public

The Powerplant and Industrial Fuel Use Act, Public Law 95-620, was signed into law by the President on November 9, 1978. The act prohibits the use of petroleum and natural gas as a primary energy source by new powerplants and industrial boilers, and it authorizes the U.S. Department of Energy (DOE) to prohibit the use of these fuels by existing powerplants and industrial boilers.

These plants and other major fuel-burning installations may be required to use alternate fuels such as coal. Coal-bed methane is also considered an alternate fuel by this Act. Although price regulations on coal-bed methane have been lifted by the Congress, the Oklahoma Corporation Commission may require that coal-bed methane shall be extracted from underground coal-mine development.

To date, the news media more than anything else have informed the public that alternate sources of energy are possible and some are available. Alternate sources of energy, primarily fuels for air, land, and sea travel, and for electric-power production, are indeed well known. On a very small scale some are in use. For example, wind, as in wind-driven generators, and solar, as in sun-heated water and panels for heating homes.

Coal-bed methane, on the other hand, is not well known because it is not well publicized. This project and report will result in coal-bed methane receiving better understanding by the public and possibly in acceptance and increased use as an alternate, unconventional source of clean-burning high-Btu direct energy.

The Colorado School of Mines Research Institute has assisted in publicizing coal-bed methane by declaring that such gas is a significant new source of natural gas, and that vast amounts of it are trapped in much of the (deep) unminable coal, in particular, in such states as Alabama, Colorado, and Oklahoma (Murray, 1980).

On the other hand, for safety purposes, energy conservation, and alternate fuel use, extraction of coal-bed methane in advance of underground mining in recoverable "shallow" coal beds is highly

desirable and feasible (Kerr-McGee, 1980; Deul and Kim, 1975; Elder and Deul, 1974).

IV. PROCEDURE

A. Geologic

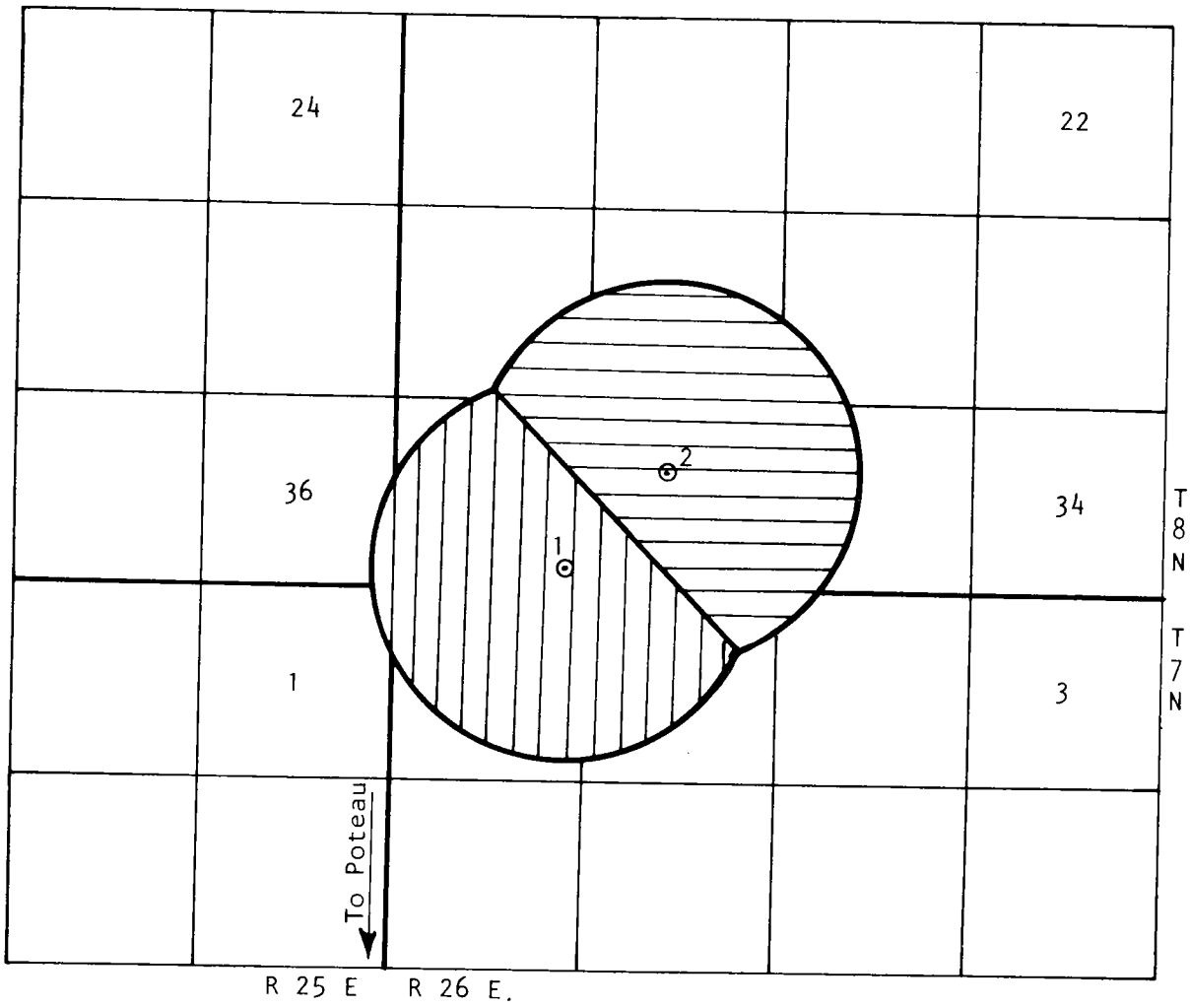
Numerous proprietary drillers' logs of coal-test boreholes were evaluated and plotted in selecting the final three locations at which to recommend the drilling of exploratory coal-bed-methane test wells. The same categories of resources and reserves were applied to coal and to the natural methane contained in the coal. That is, "measured" and "indicated" categories of reliability (Friedman, 1974) of these resources were combined in the "demonstrated" super-category.

Thus methane resources were determined only in places where coal resources have been identified based on hard data from logs of coal-test boreholes. A maximum area based on these data is determined by a circle constructed with a diameter of two miles. The areas within these circles were measured with a planimeter, and then, using the formula of the U.S. Bureau of Mines, acres and cubic feet of demonstrated coal-bed-methane resources were determined (table 1, and figs. 5, 6, and 7). The coal-bed-methane reserve maps are drawn at a scale of one inch equals one mile. Data from oil- and gas-test wells were not used, because they did not permit the determination of the exact thickness of coal beds.

The polygonal technique demonstrated on the methane reserve maps (figs. 5, 6, and 7) is a further development of the

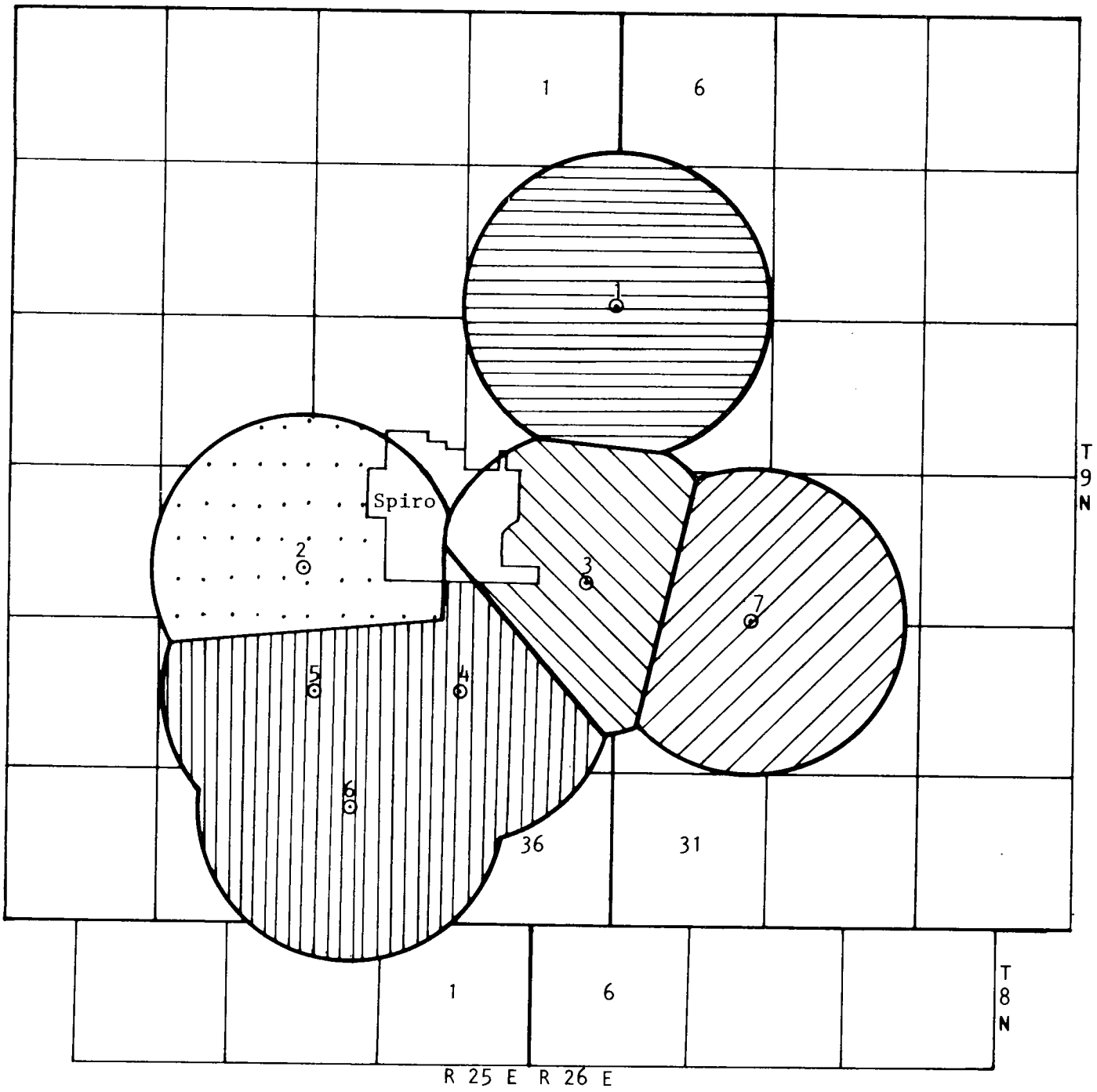
Table 1. Table of Demonstrated Resources of Coal-bed Methane in the Vicinity of Poteau and Spiro, Le Flore County, and of Keota, Haskell County, Oklahoma

Borehole No. & Corresponding Figure No.	Location Sec., T., R.	Coal-bed Thickness (feet)	Depth (feet)	Acres	Demonstrated Resources of Methane (in cubic feet)
1, 5	31, 8 N., 26 E.	4.3	1,575	1,451	6,760,905,480
2, 5	32, 8 N., 26 E.	5.6	1,509	1,451	8,804,901,160
1, 6	12, 9 N., 25 E.	3.7	1,499	1,990	7,077,315,600
2, 6	22, 9 N., 25 E.	3.8	1,416	1,515	5,533,628,400
3, 6	24, 9 N., 25 E.	3.9	1,056	1,291	4,838,421,276
4, 6	26, 9 N., 25 E.	5.4	1,191	3,070	5,344,346,053
5, 6	26, 9 N., 25 E.	5.9	1,289	3,070	5,344,346,053
6, 6	35, 9 N., 25 E.	5.0	1,079	3,070	5,344,346,054
7, 6	30, 9 N., 26 E.	4.7	928	1,664	6,081,454,080
1, 7	23, 9 N., 22 E.	2.3	1,169	1,346	2,975,682,960
1, 7	23, 9 N., 22 E.	2.3	< 1,000	475	849,528,000
2, 7	26, 9 N., 22 E.	2.9	915	1,890	4,262,025,600
3, 7	27, 9 N., 22 E.	3.0	1,101	977	2,817,277,200
			TOTAL	23,260	66,034,177,916



Hole no.	Depth (ft.)	Thickness (ft.)	Acres
1	1575	4.3	1451
2	1509	5.6	1451

Figure 5. Map showing average thickness, depth, and areas underlain by Lower Hartshorne coal, as identified by coal-test boreholes on private coal land in vicinity of Poteau, Le Flore County, Oklahoma. (Borehole numbers match those in table 1.)



Hole no.	Depth (ft.)	Thickness (ft.)	Acres
1	1499	3.7	1990
7	928	4.7	1664
4	1191	5.4	1023
5	1289	5.9	1023
6	1079	5.0	1023
2	1416	3.8	1515
3	1056	3.9	1291

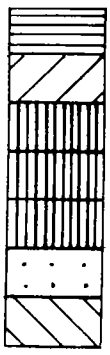
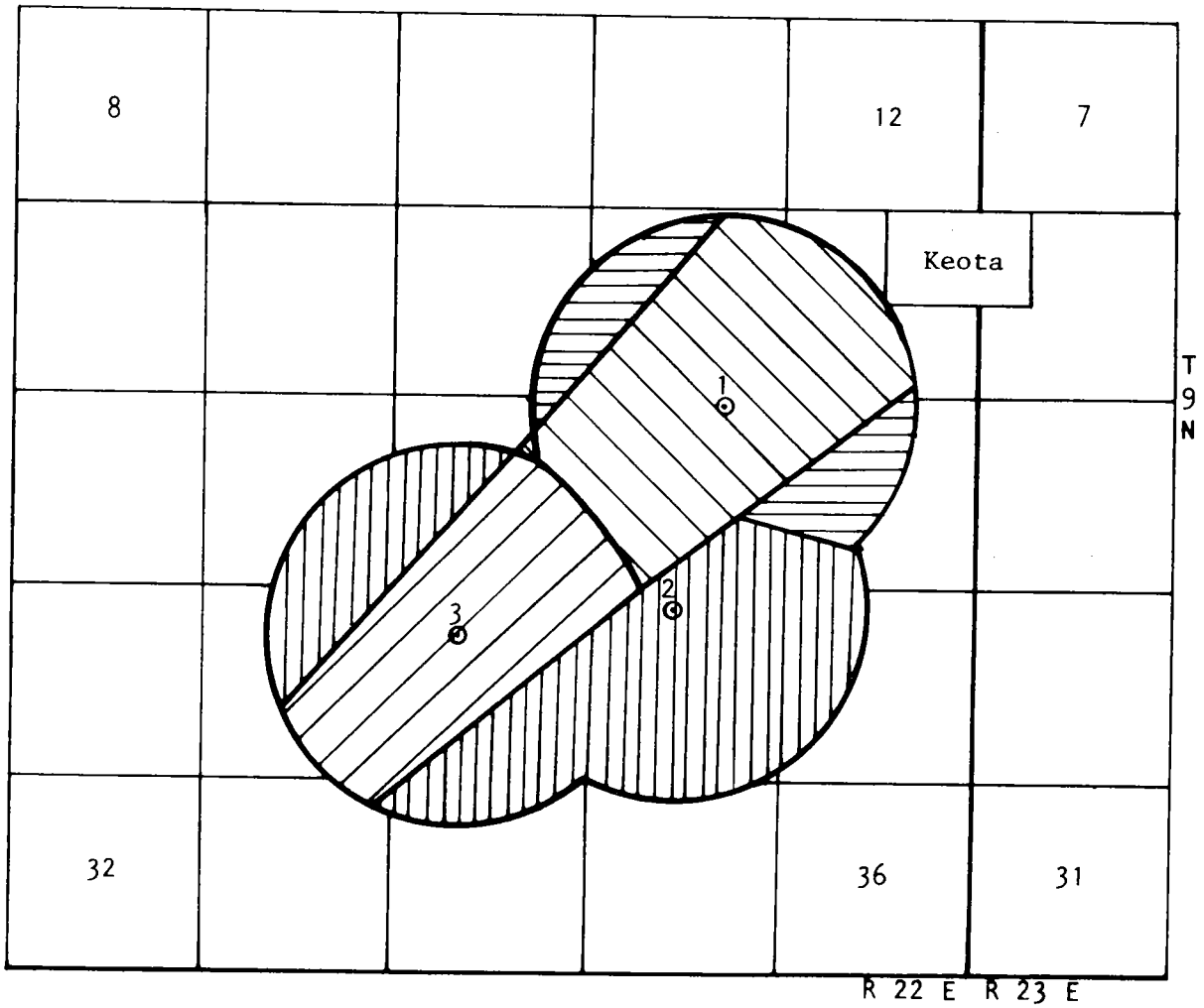


Figure 6. Map showing average thickness, depth, and areas underlain by Hartshorne coal, as identified by coal-test boreholes on private coal land in vicinity of Spiro, Le Flore County, Oklahoma. (Borehole numbers match those in table 1.)



Hole no.	Depth (ft.)	Thickness (ft.)	Acres
2,3	915	2.9	1890
3	1101	3.0	977
1	<1000	2.3	475
1	1169	2.3	1346

Figure 7. Map showing average thickness, depth, and areas underlain by Hartshorne coal, as identified by coal-test boreholes on private coal land in vicinity of Keota, Haskell County, Oklahoma. (Borehole numbers match those in table 1.)

arc-construction method. In the cases where the arcs or circles intersect each other that would normally result in an area of averaged coal-bed thickness, a straight line is drawn instead, eliminating the overlapped area by dividing it equally between the area of each of the circles. Thus each area within the resultant deformed circles is assigned to a coal thickness indicated by the appropriate borehole and shown in the small table at the bottom of each figure.

B. Socio-Economic

The vicinities of the cities of Keota, Haskell County, and Spiro and Poteau in Le Flore Counties were selected as the best locations for immediate coal-bed-methane development, because of the quantity of methane reserves determined and the positive attitude of the political and economic leaders of the cities towards this potential development.

In Keota the present writer interviewed the President of the Port of Keota and a ready-mix cement distributor.

In Spiro, the writer interviewed the Superintendent of Schools, the President of the Chamber of Commerce, a local newspaper publisher, and the City Clerk.

In Poteau interviews and extended discussions were held with members of the City Council, including the Mayor, officers of a local bank, and officials of Carl Albert Junior College.

V. RESULTS

A. Geologic

1. Coal Resources. Coal resources were determined by standard procedure (Friedman, 1974) in the areas shown on the maps for Poteau (fig. 5), Spiro (fig. 6), and Keota (fig. 7). The demonstrated coal resources are 26 million short tons in the restricted Poteau area shown, 77 million short tons in the restricted Spiro area shown, and 23 million short tons in the restricted Keota area shown.

2. Coal Reserves. Recoverable reserves of coal in the above areas by underground mining are approximately 50 percent of the total resources or 63 million tons.

3. Methane Resources. The total quantity of coal-bed-methane resources in each of the three recommended areas is 1) in the Poteau location, 15.6 billion cubic feet, 2) in the Spiro location, 39.6 billion cubic feet, and 3) in the Keota area, 10.9 billion cubic feet (table 1).

4. Methane Reserves. Recoverable reserves of coal-bed methane are conservatively estimated by using a 50 percent recovery factor. Thus a total of 33 billion cubic feet of coal-bed methane is considered recoverable from all three recommended locations. By drilling additional coal-test boreholes at each of these locations, the coal and the methane resources and reserves could be increased substantially.

B. Socio-Economic

The results of the interviews in the three rural cities were successful in that only favorable responses were obtained from

the rural and city leaders. These individuals also cooperated in that they provided the writer with important data on the consumption and cost of natural gas and electricity in their municipal and county buildings and offices. For example the city of Poteau, Oklahoma, could substitute approximately 10,000,000 cubic feet of coal-bed methane for natural gas consumed in its city offices in a 13-month period (table 2). The Le Flore County Courthouse consumed 3,843,000 cubic feet of gas in a recent 1-year period (table 2), which might have been replaced by coal-bed methane. By generating its own electric power from coal-bed methane the same courthouse would save on 427,803 kilowatt hours of electricity consumed from July, 1979, to July, 1980 (table 2).

The public buildings and offices located in Le Flore County used electricity that cost an average of $0.04 (four cents) per kilowatt/hour. These buildings and offices consumed natural gas that cost an average of $1.38 per thousand cubic feet. County- and city-owned coal-bed methane wells could save these governments substantial funds.

In the three cities, these officials expressed great interest in local coal-bed-methane reserves and development, including utilization in municipal and school buildings. They were interested in the potential economic aspects of the methane program. That is, these officials would consider direct government subsidy, matching government subsidy, or private funding for the coal-bed-methane exploration, production, maintenance, and utilization. Their attitudes were cooperative, receptive, open, and anticipatory.

Table 2. Table Showing Quantities* and Costs* of Electricity and Natural Gas Consumed in Selected County and Municipal Offices and Buildings in Haskell and Le Flore Counties, Oklahoma

Place	Period	Electricity		Natural Gas	
		Kilowatt hours	Total Cost	Thousand cubic feet	Total Cost
Le Flore County Courthouse	July 1979 to July 1980	427,803	$17,046.09	3,843	$3,789.15
Carl Albert Junior College	June 30,1979 to June 30,1980	644,959	26,489.02	3,304	4,588.57
Employment Office	October 1979 to September 1980	58,459	2,734.11	--	--
Poteau Schools	October 1979 to September 1980	673,295	27,969.88	7,949	11,060.56
Poteau City Offices	October 1979 to September 1980	2,144,111	74,992.51	10,422	18,116.31
Le Flore County Memorial Hospital	October 1979 to September 1980	1,907,465	67,464.31	11,243	15,727.42

*As reported.

The City Council and the Mayor of Poteau are on record to support Carl Albert Junior College in its effort to lead in exploring, drilling, producing, and utilizing coal-bed methane in the Poteau area.

VI. CONCLUSIONS AND RECOMMENDATIONS

Twenty-six rural towns and cities in four counties in the Arkoma Basin area were evaluated for their proximity to and likelihood for potential recovery of identified coal-bed-methane resources.

The rural towns and cities in Haskell County are Keota, Kinta, McCurtain, Stigler, and Tamaha. All but Keota are located too distant (several miles) from sufficient numbers of coal-test boreholes whose drillers' logs provided data for identified, demonstrated, remaining coal resources at depths of 500-1,800 feet.

The rural cities in Latimer County that were considered are Red Oak and Wilburton. Some coal-test boreholes are present in the vicinity of these towns, but the single deciding factor eliminating them as sites for recoverable coal-bed methane is insufficient private coal-lease areas. Most of the identified coal resources in this region are Federal and are owned by the U.S. Department of the Interior. This Federal Department has made it clear that it is not ready to lease its coal for the recovery of coal-bed-methane resources.

The rural towns and cities under consideration in this study for coal-bed-methane recovery in Le Flore County were Bokoshe, Cameron, Cowlington, Fanshawe, Heavener, Howe, Le Flore, Panama, Pocola, Poteau, and Spiro. All but Spiro and Poteau were too

distant from reliable coal-bed data, at or close to unavailable Federal coal leases, within areas where the Hartshorne coals were not present between the assigned limits of 500-1,800 feet deep, or too close to abandoned underground coal mines.

The Pittsburg County towns and cities that were considered are Canadian, Crowder, Haileyville, Hartshorne, Indianola, Krebs, McAlester, and Quinton. McAlester's recorded population of 18,802 eliminates it for consideration as a rural city for the purposes of this study. The other cities and towns do not qualify, because too many Federal coal resources are present, abandoned underground coal mines are present or too close, insufficient coal resources have been identified by coal-test boreholes, or the Hartshorne or McAlester coal was not present between the assigned limits of 500-1,800 feet deep.

Therefore, it is concluded that Spiro and Poteau and vicinities in Le Flore County, and Keota and vicinity in Haskell County, are the best locations in this order for immediate exploration, development, production, and utilization of identified remaining coal-bed-methane resources.

This conclusion is based upon the facts that (1) sufficient coal data are present at these locations, to identify quantities of coal and of coal-bed-methane resources and recoverable reserves; (2) sufficient private (non-public or non-Federal) coal leases are present in each area; (3) the coal data, leases, and estimated coal-bed-methane reserves are within 5 miles of a rural townsite; (4) any abandoned underground mines are more than one-half mile from the

rural town or city and do not border on the area of identified coal-bed-methane resources; and (5) the Hartshorne coals are present at depths of 500 to 1,800 feet.

The political and private attitudes towards the coal-bed-methane potential production and utilization were excellent in all three cities. An important public institution of higher education, Carl Albert Junior College near Poteau, expressed through its highest officials a desire to assist and cooperate in the exploration, production, and utilization of the recoverable coal-bed methane in the Poteau area. The college is supported in this desire by the City of Poteau.

Thus, ranking of these three cities for primary and alternate sites for potential coal-bed-methane drilling sites, exploration, and development is based primarily upon the coal-bed-methane resources that have been identified to date in this study and report (see table 1 and figs. 5-7).

Spiro and vicinity contain 39.6 billion cubic feet of identified, remaining, demonstrated coal-bed methane, of which a conservative estimate of 20 billion cubic feet is recoverable reserves. Therefore Spiro and vicinity are the recommended primary site for developing this alternate fuel.

Poteau and vicinity contain 15.6 billion cubic feet of this gas of which some 8 billion is recoverable reserves. Coal-bed discontinuity and paucity of deep coal-test boreholes relegate this area to the first alternate position.

Keota and vicinity contain at least 10.9 billion cubic feet of identified, remaining, demonstrated, coal-bed-methane resources, of which approximately 6 billion cubic feet is recoverable reserves. This area is the second alternate site recommended for exploration, development, production, and utilization.

In the opinion of the writer, these three recommended areas probably contain additional resources of coal-bed methane that could be identified by drilling and by the same techniques referred to in this report. Further, there are undoubtedly many other possible locations in the Arkoma Basin in Oklahoma that would be suitable for exploration and production of coal-bed methane.

The only constraints on coal-bed-methane development and utilization that seem logical at present to the writer might be the public's lack of knowledge and resultant apathy concerning the resource; conflicting land use concerning gathering and user pipelines; and conflicting business interests concerning parallel routes of pipelines of local gas companies and of power lines of local electricity companies, which might not favor the potential competition from unconventional coal-bed methane, no matter how small that competition might be.

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