Illinois

The coalfields of Illinois, Indiana, and western Kentucky constitute the Eastern Region of the Interior Coal Province, known better as the Illinois Basin. About 36,800 square miles in Illinois are underlain by the coal-bearing sequence of rocks that constitute the Pennsylvanian System.

General Coal Characteristics

Rank - Illinois coals cover the full range of the high-volatile bituminous coals. Studies indicate that the calorific value of Illinois coals increases systematically from about 11,000 Btu/lb (moist, mineral-matter-free) in the northwestern part of the coalfield to about 15,000 Btu/lb in the southeastern part of the state (Table 1). Across the same area, moisture (mmf) drops from around 20% to less than 5%. The increase in rank with increase in depth at a given point is not as well exhibited as the regional increase in rank from the northwest to the south and southeast. An increase of 100 ft in depth corresponds to about 150 Btu/lb increase in calorific value in the lower rank coals of northern Illinois and to about 60 Btu/lb increase in the higher rank coals of southern Illinois.

Ash and Mineral Matter - The occurrence of ash is irregular and unpredictable for large areas of the individual coal seams. Illinois coals with an ash content (on an as-received basis) of less than 6% are unusual. On the other hand, an ash content of more than 14% (exclusive of readily discardable bedded impurities more than 3/8-in. thick) also is unusual. The average ash content of Illinois coals is about midway between these two extremes, or about 10%, with local variations commonly in the order of 2 to 3%.

Ash must not be confused with mineral matter which is the form in which most in-combustible components occur in coal. The composition of mineral matter in Illinois coals varies significantly from place to place and between coal seams. The data in the following table were computed from a large number of channel samples for the two principal coals mined in Illinois; it shows average weight percentages as well as ranges of the main minerals found in Illinois coals, on a whole coal basis:

	Herrin coal	Springfield coal
Clay minerals	9.4(5.0-13.5)	7.0 (3.0 -13.)
Quartz	2.4(1.0-3.8)	2.4(1.2-4.3)
Pyrite	3.4(1.0-11.6)	3.9(0.5-18.0)
Calcite	1.3(0.3-5.2)	1.6(0.3-4.9)
Total minerals*	16.5(10.7-22.7)	14.8(9.8- 28.0)

*= weight % low temperature ash

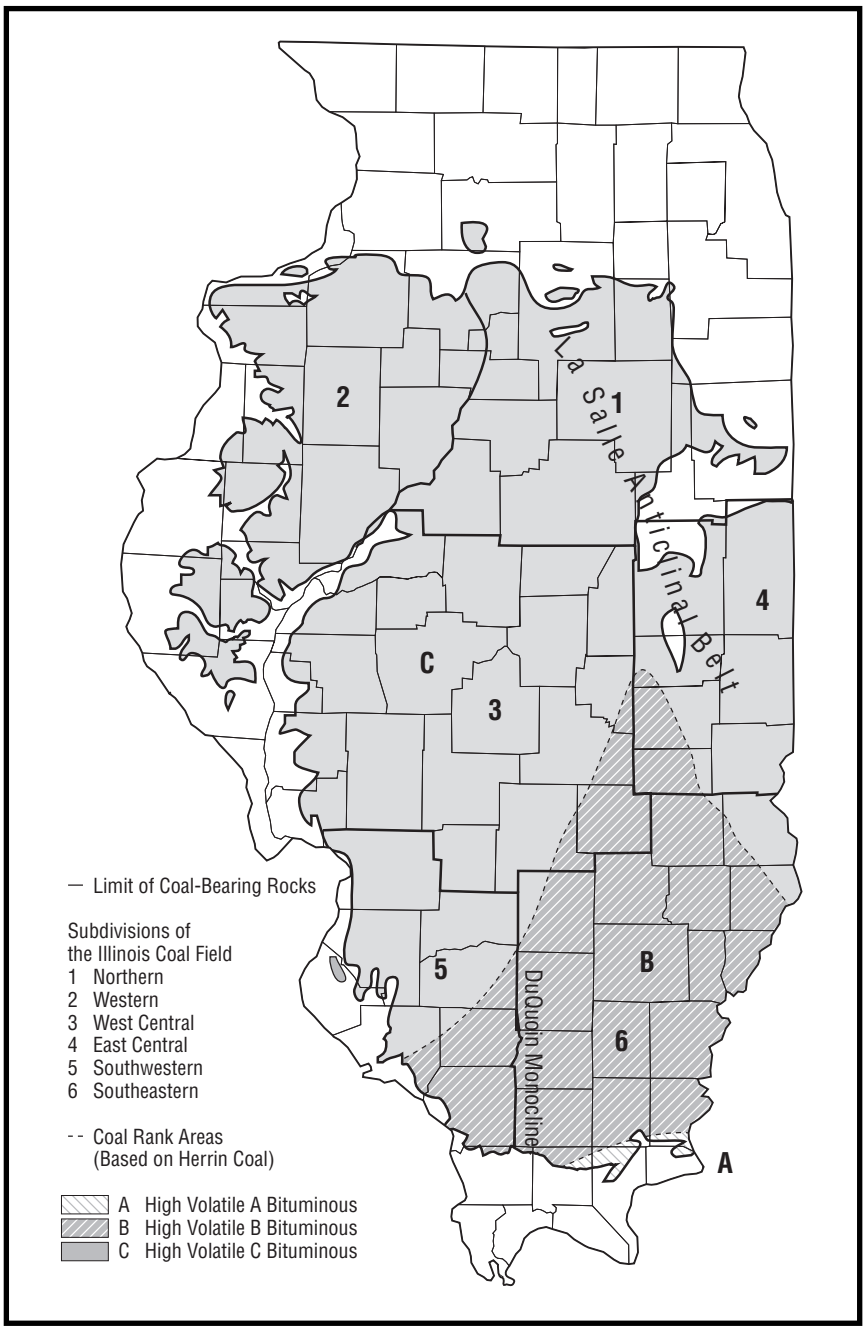


Fig. 1. Subdivisions of the Illinois coalfield and approximate areas of high-volatile A, B and C bituminous rank coals based on the Herrin Coal

Sulfur - Sulfur in Illinois coalbeds is commonly related to the character of the strata overlying the coal. Usually the coals are overlain by marine strata, most commonly by marine black fissile shale or limestone. The sulfur content of the coal below such strata normally ranges from 3 to 5%. In certain areas, however, nonmarine, silty gray shale units intervene between the coal and the overlying black shales and limestones. When the gray shale exceeds about 20 ft in thickness, the sulfur content generally is less than 2.5%, commonly averaging 1.5%.

Total sulfur content of Illinois coals has been reported from as low as 0.5% to more than 7%. The sulfur content is less than 2.5% in a few significant areas; the resources in these areas are estimated to constitute about 8% of the remaining resources. The organic sulfur content of Illinois coals varies from a minimum of about 0.4% to a maximum of about 3%. Pyritic sulfur varies from nearly zero to values of 4 to 5%-Sulfate sulfur constitutes only a negligible amount; it results from weathering of pyrite in coal.

Table 1. Typical ranges of analyses for coals in northwest and southeast Illinois

	Moist, mineral-matter-free basis		Dry, mineral-matter-free basis					
	Calorific Value (Btu/lb)	%Bed Moisture	%Carbon	%Oxygen	%Hydrogen	%Vol Fixed Matter	%Fixed Carbon	R*
Northwest	11,000-11,600	18-21	75-78	10.5-13.5	5-6	40-53	47-60	.43-.60
Southeast	13,700-15,000	4-7	81-84	5-8	5-6	36-43	57-64	.65-.90

R*-% reflectance of polished vitrinite under oil immersion

Trace and Minor Elements- Most trace elements in Illinois coals occur in abundances not greatly different from those in the average rock making up the crust of the earth. Only boron, chlorine, and selenium are significantly enriched. An economic potential may exist for removal of certain elements that are valuable and otherwise scarce, such as rare earths or zinc. These elements commonly occur in amounts up to 0.2% of the whole coal and up to 1.5% or more of coal slurry and refuse in some samples from western Illinois. They may be further concentrated in fly-ash.

The 1990 Amendments to the Clean Air Act listed a number of minor and trace elements that commonly occur in coal as "hazardous air pollutants" (HAPs). The following list provides the arithmetic averages and standard deviations of the HAP elements for coals currently marketed by Illinois mines.

Essentially all coal shipped from Illinois mines is cleaned. The concentrations of most trace and minor elements are reduced significantly during the cleaning process because of the close association of most elements with mineral matter in coal.

Average trace and minor element composition of coal shipped by Illinois mines (dry basis, in parts per million, except for sulfur) based on 34 samples:

	Element	Arithmetic Mean	Standard Deviation
As	Arsenic	7.5	8.1
B	Boron	90	45
Be	Beyllium	1.2	0.7
Cd	Cadmium	0.5	0.9
Cl	Chlorine	1671	1189
Co	Cobalt	3.5	1.3
Cr	Chromium	14	6
Cu	Copper	9.2	2.5
F	Fluorine	93	36
Hg	Mercury	0.09	0.06
Li	Lithium	9.4	7.1
Mn	Manganese	38	32
Mo	Molybdenum	8.4	5.7
Ni	Nickel	14	5
P	Phosphorus	87	83
Pb	Lead	24	21
S	Sulfur	2.88%	0.99%
Sb	Tin	0.9	0.7
Se	Selenium	1.9	0.9
S	Sulfur	2.88%	0.99%
Sb	Tin	0.9	0.7
Se	Selenium	1.9	0.9
Th	Thorium	1.5	0.4
U	Uranium	2.2	1.9
V	Vanadium	31	16
Zn	Zinc	84.4	84.2

Table 2. Correlation of coal seams and rock formations in the Illinois Basin

Illinois		Indiana		West Kentucky		Standardized Terms	
Modesto Fm.		Shelburn Fm.		Sturgis Fm.	Coiltown (W. Ky. No.14) Baker (W. Ky. No. 13) Paradise (W. Ky. No. 12)	Shelburn Fm.	
Carbondale Fm.	Danville (No. 7) Jamestown Herrin (No. 6) Springfield (No. 5) Summum (No. 4) Shawneetown Colchester (No. 2)	Dugger Fm. Petersburg Fm. Linton Fm.	Danville (VII) Hymera (VI) Herrin Springfield (V) Houchin Creek Survant (IV) Colchester (IIIa)	Carbondale Fm.	Herrin (W. Ky. No. 11) Briar Hill (W. Ky. No. 10) Springfield (W. Ky. No. 9) Ruff Well Dekoven (W. Ky. No. 7) Davis (W. Ky. No. 6)	Carbondale Fm.	Herrin Springfield Houchin Creek Survant Colchester
Spoon Fm.	Dekoven/Seelyville Davis Murphysboro New Burnside Bidwell Rock Island (No.1)	Staunton Fm. Brazil Fm.	Seelyville (III) Buffaloville Minshall Upper Block Lower Block	Tradewater Fm.	Manningtown (W. Ky. No.4) Bell (W. Ky. No. 1b)	Tradewater Fm.	
Abbott Fm.	Willis Reynoldsburg	Mansfield Fm.	Mariah Hill Blue Creek St. Meinrad Pinnick French Lick				
Caseyville Fm.	Gentry			Caseyville Fm.	Main Nolin	Caseyville Fm.	

Coking - Illinois coal is agglutinating when freshly mined, but for the lower ranks of these coals, only weakly so. In general, coking character improves southward with the rank of the coal. Low-sulfur coals produced from the Herrin (No. 6) and Springfield (No. 5) coals in southern Illinois are used commercially in blends with higher rank coking coals from the Appalachian coalfields to produce good metallurgical coke.

Coal Seam Nomenclature

The coals of Illinois are referred to by geographic names; however, several of the more important coals also are commonly referred to by number; the lower the number, the older the coal (Table 2). In Illinois a double-name scheme was used until recently on the numbered coal members, such as Danville (No. 7), Herrin (No. 6), Springfield (No. 5), Colchester (No. 2), and Rock Island (No. 1) coals. The stratigraphic correlation of Illinois, Indiana, and western Kentucky coals is shown in Table 2. The recently adopted basin-wide standardized names of the right column of Table 2 are used throughout this text.

Mining Areas

Many different systems have been used to subdivide the coal-producing areas of Illinois. In the following text, Illinois has been subdivided as shown in Fig. 1.

I. Northern Area - In the northern area, underground mining of coal was carried on extensively in the period between 1875 and 1928. Much of the early mining was done by the historic longwall method. After 1915, however, coal production in northern Illinois began to decline due to development of more profitable mining operations in southern Illinois.

Surface mining began in the area about 1928 and, subsequently, all underground mines closed. Since then, practically all of the coal mined in northern Illinois has been from surface operations. The Colchester coal was extensively surface-mined in southwestern Will, western Kankakee, and eastern Grundy

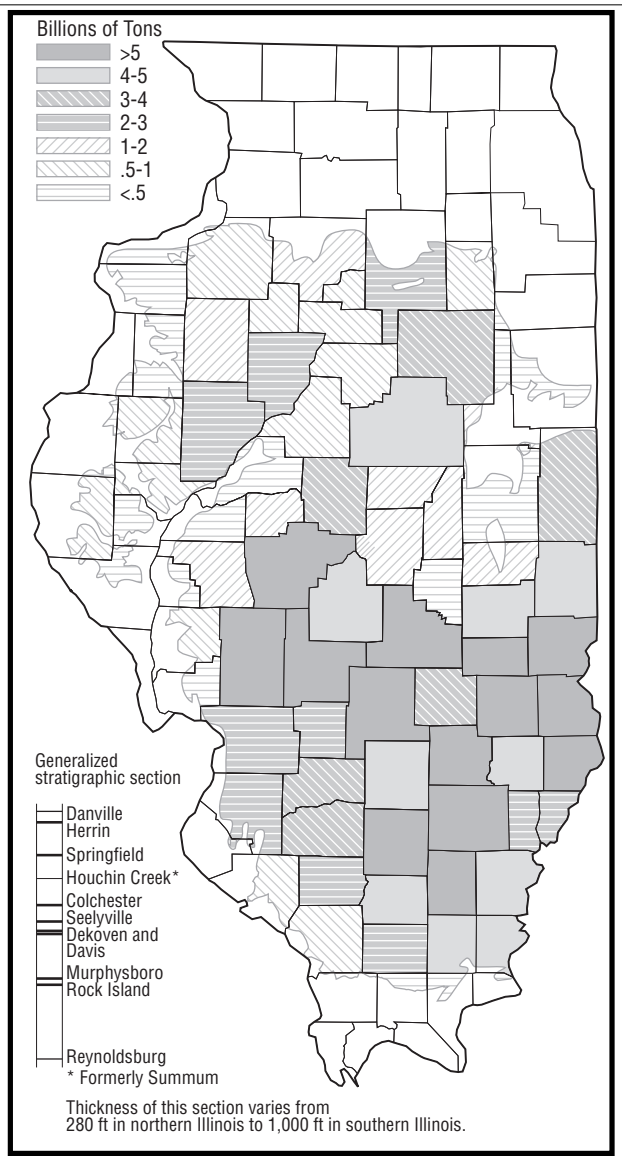


Fig. 2. Remaining coal resources in Illinois, by county

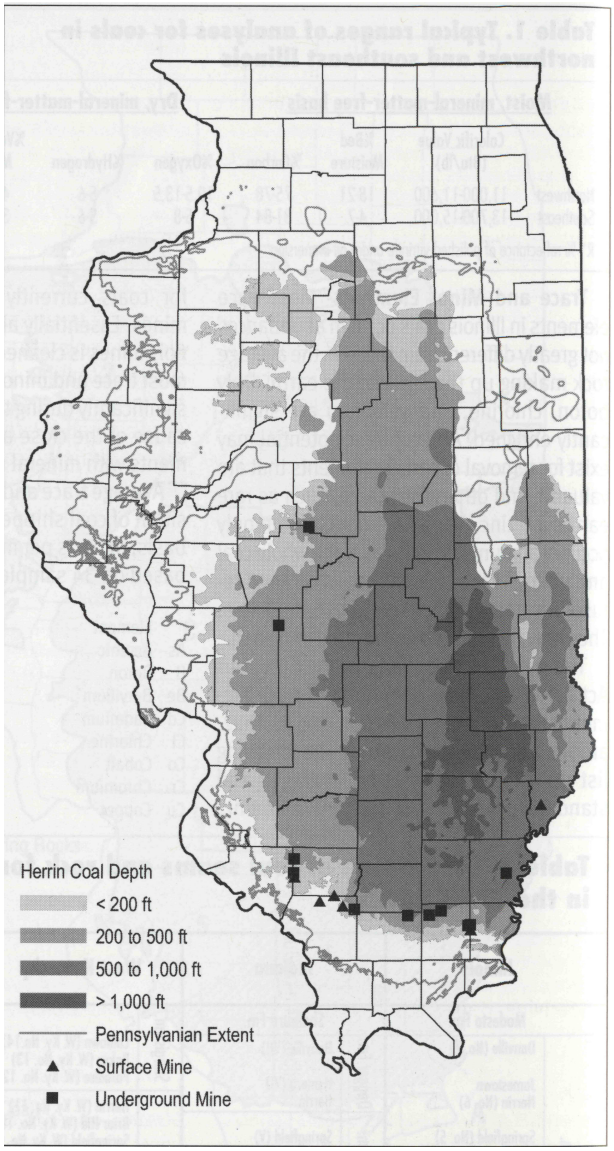


Fig. 3. Active coal mines, June 2009

counties, and less extensively north of the Illinois River near Morris and westward from the vicinity of Ottawa to Utica in La Salle County. The Houchin Creek was locally surface-mined in eastern Grundy County.

West of the La Salle Anticlinal Belt (Fig. 1) the Colchester coal formerly was mined underground at numerous places in Putnam, Bureau, and La Salle counties. The overlying Herrin and Danville coals also have been mined where they are locally thick.

The Danville coal has been mined underground locally near Pontiac and Fairbury in southern Livingston County and near Chenoa and Colfax in northeastern McLean County. At Bloomington, in central McLean County, the Colchester and Springfield coals were mined underground. The Springfield seam also has been mined underground near Pekin, in Tazewell County.

At present, there are no operating mines in the northern Illinois area (Fig. 3). The last mine in this area was abandoned in 1974. Although some drilling for potential underground minable coal has occurred west of the La Salle Anticlinal Belt, there has been relatively little exploration in the northern Illinois area in recent years.

2. Western Area - The western Illinois area includes all of the coalfields west of the Illinois River and the western half of Bureau County (Fig. 1). Extensive areas of the Springfield coal in the vicinity of Canton were favorably situated for surface mining, becoming the sites of some of the earliest large-scale surface mines in the United States. In the past, there were numerous shaft and slope mines throughout western Illinois, but most production since the 1950s has come from surface mines. Most coal produced in western Illinois has been from the Springfield and Herrin seams. The Colchester coal is the most widespread of all western Illinois coals, but is presently not being mined. It is not as thick as the Springfield and Herrin coals and has not been so extensively surface-mined. It was previously surface-mined in Schuyler and McDonough counties. The Rock Island coal formerly was produced in a number of relatively small mines in Rock Island, Mercer, Henry, Warren, Knox, and Fulton counties.

3. West-Central Area - Currently, mines operate in the west-central Illinois area in

Logan and Macoupin counties (Fig. 3). Only one mine produces from the Springfield seam; all other mines produce from the Herrin coal, which is the principal minable seam throughout the southern two-thirds of the region (Fig. 8). Large mines have operated in this area for many years. One area with relatively low-sulfur Herrin coal resources now supports a large underground mine in Macoupin County (Fig.10). In the northern one-third of the area, the Herrin seam is thinner and of less importance. In this northern part of the area, the underlying Springfield coal is 4 to 6 ft thick (Fig. 9) and has been extensively mined in the vicinity of Springfield; currently one large underground mine operates in this area. Smaller operations also have taken place in Sangamon, Logan, Menard, and Macon counties. Remaining resources within this area are extensive (Table 3).

There has been some small-scale surface mining as well as shallow underground mining of the Shelbyville coal within Shelby County, in the vicinity of Shelbyville and Fancher. This coal lies several hundred feet above the Herrin coal and averages 2 ft in thickness in the area where it has been mined.

4. East-Central Area - In recent years, all of the operating mines in the east-central area (Fig. 3) have been in Vermilion and Douglas counties. The Danville seam has been extensively surface-mined and exploited in many small underground mines in the Danville area of Vermilion County. The underlying Herrin coal has been mined mostly by underground methods south of Danville (Vermilion County), and near Murdock in eastern Douglas County, where the Herrin has a low to medium sulfur content. The coal also has been mined along the outcrop in Vermilion County. Recent exploration reportedly has outlined an area of relatively low-sulfur Danville coal in Clark County. The Springfield coal, which is thin under most of Vermilion and Douglas counties, formerly was produced from several small mines in Edgar County.

5. Southwestern Area - The boundary between the southwestern and southern areas is along the Du Quoin Monocline (Fig.1). This is a relatively prominent structural feature trending north-south that separates the deeper part of the Illinois Basin on the east from the shelf area to the west. The Herrin seam is the principal coal mined in the region. However, the underlying Springfield coal, not continuously well developed over this area, also has been surface-mined in Randolph and Perry counties. One area of low-sulfur Herrin coal has been mapped in the vicinity of Troy, including a portion of Madison and St. Clair counties (Fig. 10).

Most production in the southwestern region in recent years has been from large-scale surface mining of relatively thick Herrin coal along the western margin of the coalfield (Fig. 3). Numerous underground mines, some relatively large, have been operated in Madison, St. Clair, Randolph, and Clinton counties. The southwestern Illinois area, along with the southern part of the west-central area, contains the most widespread thick Herrin coal in Illinois and large resources of this coal are present (Table 3, Fig. 8). A few underground mines in the Herrin seam within this area have been operated at shallow depths (less than 150 ft) due to the relatively thick amount of stabilizing limestone present within this interval. In several areas, where the Springfield is present in sufficient thickness and at an interval of about 25 ft below the Herrin coal, both seams have been mined together by surface operations. In southeastern and central Jackson County, the Murphysboro Coal was extensively deep mined between the 1880s and 1940s, and thereafter surface mined in the central and north-central parts of the county. This includes small surface operations that are currently active.

6. Southeastern Area - The southeastern Illinois area has the largest number of operating mines of any of the six areas described (Fig. 3). The greatest quantity of coal is being mined from the Herrin and Springfield seams, principally in Saline, Gallatin, and Williamson counties. The Davis and Dekoven coals underlying the Springfield seam have been surface-mined along their outcrops in the southeastern Illinois area.

Southeastern Illinois contains several areas (Figs. 10 and 11) of relatively low-sulfur coal in both the Springfield and Herrin, the two seams which account for the bulk of present production. Extensive surface mining has occurred along the outcrops of the coals in Williamson, Saline, and Gallatin counties.

In southern Gallatin, Williamson, and Saline counties and northern Johnson, Pope, and Hardin counties are local, relatively thin occurrences of older and higher rank coals, some of which have been mined by small drift and surface operations. The Seelyville coal, which lies 160 to 240 ft below the Springfield coal, now has been correlated with the Dekoven and Davis seams (Table 2). It attains sufficient thickness in the northern part of Area 6 and the southern part of Area 4 to warrant exploration. Although the seam has been mined in Indiana, information on its occurrence in Illinois now primarily is based on geophysical logs obtained during exploration for oil.

A large area in southeastern Illinois where oil production has been significant has not been prospected adequately for coal. In much of this area, the Herrin coal generally lies at depths of 650 to more than 1,200 ft (Fig. 3). Using primarily geophysical logs from oil wells, resources of both the Herrin and Springfield seams have been mapped in this deeper portion of the basin.

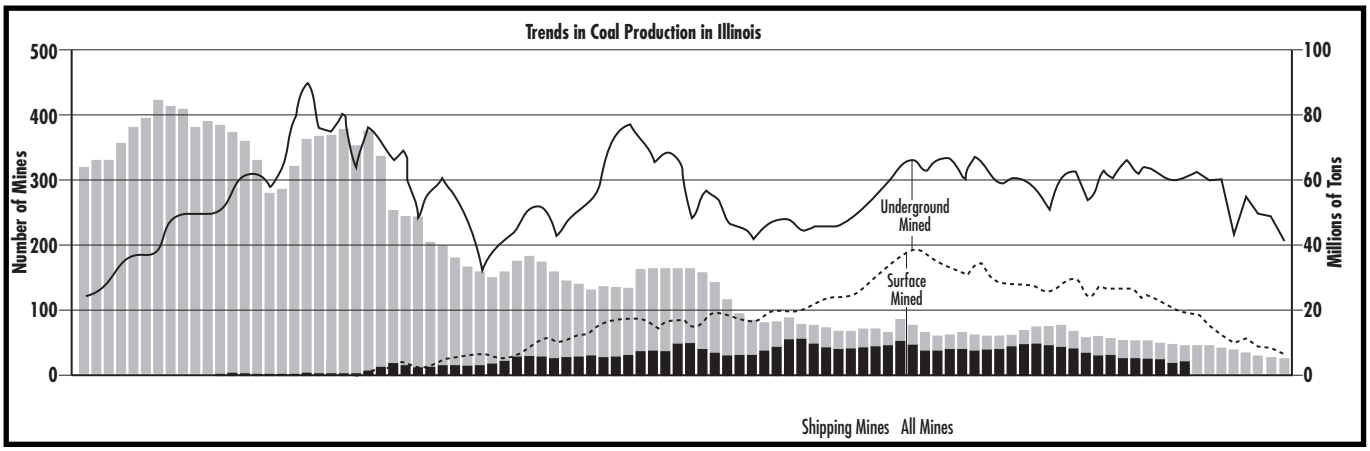


Figure 4: Trends in Illinois coal production, 1900-1998 (Data from Illinois State Dept. of Natural Resources, Office of Mines and Minerals)

Relatively thin coals, occurring at shallow depths several hundred feet above the Herrin coal, have been mined from time to time in southeastern Illinois. Production from these stratigraphically high coals has been principally in the vicinities of Opdyke in southeastern Jefferson County, Calhoun in Richland County, Friendsville and Cowling in Wabash County, Flat Rock in Crawford County, and Corinth in Williamson County.

Coal Resources

Illinois has the largest reported bituminous coal resource and the largest strippable bituminous coal resource of any state in the United States. Illinois has the third largest total coal resource of any state and is second only to Montana in terms of demonstrated reserve base. About 20 coal seams have been mined in Illinois. Most production, however, has come from about eight coal seams, with 85 to 90% of the total production being from the Herrin and Springfield seams. Illinois currently produces about 35 million tons of coal per year, down from about 60 million tons per year between 1966 and 1992. Surface mining accounts for about 10-15% (Fig. 4) of the total.

The U.S. Department of Energy defines the "demonstrated reserve base" (DRB) as representing that portion of the total coal resource that is potentially minable under current economic conditions. The DRB is defined primarily in terms of a minimum thickness and degree of geologic assurance of its presence. Nearly 54% of the total remaining resources of Illinois meet DRB specifications. The recoverable reserves listed in the last column of Table 3 are derived from the DRB by accounting for factors that limit the accessibility of in-place coal (e.g. thin coal, resources left as barrier pillars or underlying towns, etc.), as well as losses due to mining and cleaning.

Based on DRB calculations, approximately 11%, or 22 billion tons, of Illinois coal resources are classified as surface minable or strippable (Table 3). Strippable coal resources are defined as mapped coal greater than 18 in. thick and with less than 150 ft of overburden. Fig. 5 shows the distribution of

Table 3. Remaining identified coal resources in Illinois by county and seam, Novermber 2009 (millions of tons)

County	Danville (No.7)	Jamestown	Herrin (No.6)	Springfield (No.7)	Colchester (No.2)	Seelyville	Dekoven	Davis	Rock Island (No.1)	Misc.	Resources Total	Resources Surface	Recoverable Reserves
ADAMS	0	0	0	0	616	0	0	0	0	0	616	616	154
BOND	0	0	2,518	0	2	0	0	0	2	0	2,522	0	928
BROWN	0	0	0	0	371	0	0	0	0	0	371	363	142
BUREAU	415	0	680	0	632	0	0	0	0	0	1,729	462	341
CALHOUN	0	0	0	0	12	0	0	0	0	0	12	12	6
CASS	0	0	0	137	232	0	0	0	0	0	369	330	122
CHAMPAIGN	162	0	200	0	0	0	0	0	0	0	363	0	94
CHRISTIAN	63	0	3,440	1,232	0	0	0	0	43	0	4,779	0	1,394
CLARK	1,611	683	419	1,663	0	1,064	0	0	0	0	5,441	158	647
CLAY	0	0	2,053	1,995	0	33	0	0	0	0	4,083	0	0
CLINTON	0	0	3,199	99	0	0	0	0	0	0	3,298	0	1,059
COLES	1,140	0	1,107	1,080	0	748	0	0	0	0	4,076	146	192
CRAWFORD	1,212	1,500	366	1,278	0	2,199	0	0	0	50	6,607	50	318
CUMBERLAN	893	0	1,785	1,315	0	1,335	0	0	0	2	5,332	3	892
DEWITT	0	0	0	1,496	0	0	0	0	0	0	1,496	0	0
DOUGLAS	81	0	1,195	459	0	0	0	0	0	0	1,736	199	431
EDGAR	1,613	0	1,532	772	0	877	0	0	0	0	4,796	401	991
EDWARDS	0	0	924	1,120	0	0	76	672	0	0	2,794	0	133
EFFINGHAM	1,202	0	1,334	2,176	0	376	0	0	0	1	5,090	1	454
FAYETTE	307	0	3,642	2,287	0	0	0	0	0	1	6,239	1	738
FORD	0	0	0	40	0	0	0	0	0	0	40	0	0
FRANKLIN	0	0	1,395	2,066	0	0	379	566	0	78	4,485	3	1,322
FULTON	56	0	246	656	1,254	0	0	0	8	0	2,221	1,952	1,021
GALLATIN	0	0	932	1,263	0	0	956	1,266	0	6	4,424	328	1,234
GREENE	0	0	95	0	612	0	0	0	0	0	708	593	251
GRUNDY	0	0	44	0	803	0	0	0	0	115	963	461	258
HAMILTON	0	0	2,597	2,426	0	0	738	1,116	0	0	6,878	0	1,807
HANCOCK	0	0	0	0	29	0	0	0	0	0	29	29	15
HENDERSON	0	0	0	0	53	0	0	0	0	0	53	53	0
HENRY	56	0	249	0	236	0	0	0	64	0	605	601	210
JACKSON	0	0	78	242	0	0	0	0	0	335	656	322	152
JASPER	1,243	0	2,904	2,139	0	2,147	0	0	0	0	8,434	0	1,507
JEFFERSON	0	0	2,624	2,878	0	0	0	0	0	29	5,532	29	1,092
JERSEY	0	0	60	0	269	0	0	0	0	0	329	219	75
KANKAKEE	0	0	0	0	62	0	0	0	0	14	77	26	14
KNOX	21	0	212	621	732	0	0	0	51	0	1,640	1,560	697
LASALLE	560	0	283	0	1,391	0	0	0	0	74	2,309	590	422
LAWRENCE	1,128	1,398	821	1,499	0	553	0	0	0	156	5,558	0	539
LIVINGSTON	1,816	0	162	213	1,500	0	0	0	0	145	3,838	846	265
LOGAN	0	0	823	2,807	0	0	0	0	0	0	3,630	0	767

strippable resources by average seam thickness. Underground coal resources consist of all mapped coal more than 28 in. thick and greater than 150 ft deep. The approximately 189 billion tons of underground resources include coal within areas heavily drilled for oil and gas. Fig. 6 shows underground resources by thickness category.

The resources include substantial amounts of coal that likely cannot currently or in the foreseeable future be mined economically. U.S. Geological Survey-sponsored studies conducted from 1999 through 2003 found that approximately 46% of the remaining resources are "available for mining", i.e. the resources are expected to have mining conditions comparable to those currently being successfully mined; 4.7 billion tons are estimated to be available by surface mining methods and 92 billion tons by underground methods. These studies used slightly different definitions than the DRB calculations for estimating remaining surface and underground-minable resources, and in the delineation of these resources that have the most favorable geologic and land-use characteristics for mining. Land-use restrictions include man-made or natural features that are illegal or impractical to disturb by mining. Technological restrictions include geologic or mining-related factors that negatively impact the economics or safety of mining (e.g. resources near sandstone channels, major faults, or with insufficient thickness of bedrock cover). Coal resources in the available category are not necessarily economically minable at the present time, but the term designates that these deposits are expected to have mining conditions comparable to those currently being successfully mined (Fig. 7).

Coal Seams

In the following look at individual coals, analytical data are presented in table form. These data are largely from published reports of the Illinois State Geological Survey and subsequent unpublished analyses. In the tables, a "range of typical analyses" is given from which all unusual values were excluded. All data are based on standard face

County	Danville (No.7)	Jamestown	Herrin (No.6)	Springfield (No.7)	Colchester (No.2)	Seelyville	Dekoven	Davis	Rock Island (No.1)	Misc.	Resources Total	Resources Surface	Recoverable Reserves
MCDONOUGH	0	0	0	0	578	0	0	0	0	0	578	578	193
MCLEAN	1,703	0	75	3,955	286	0	0	0	0	0	6,021	0	326
MACON	0	0	341	2,382	0	0	0	0	0	0	2,724	0	221
MACOUPIN	16	0	3,817	0	1,576	0	0	0	695	142	6,248	542	1,612
MADISON	0	0	2,220	0	229	0	0	0	7	4	2,461	630	856
MARION	0	0	1,874	2,489	0	0	0	0	0	0	4,364	0	202
MARSHALL	362	0	7	0	493	0	0	0	0	0	862	115	80
MENARD	0	0	12	1,151	0	0	0	0	0	0	1,163	561	361
MERCER	0	0	0	0	15	0	0	0	54	0	69	69	2
MONROE	0	0	7	0	0	0	0	0	0	0	7	7	4
MONTGOMERY	53	0	3,832	0	554	0	0	0	509	648	5,598	0	1,597
MORGAN	0	0	423	38	1,152	0	0	0	0	0	1,614	359	177
MOULTRIE	0	0	1,066	66	0	0	0	0	0	0	1,132	0	82
PEORIA	276	0	1,127	1,200	362	0	0	0	0	0	2,967	2,144	1,169
PERRY	0	0	1,836	321	0	0	0	0	0	642	2,800	700	1,147
PIATT	0	0	85	1,289	0	0	0	0	0	0	1,335	0	0
PIKE	0	0	0	0	145	0	0	0	0	0	145	145	65
PUTNAM	218	0	77	0	374	0	0	0	0	0	671	0	43
RANDOLPH	0	0	248	178	0	0	0	0	0	0	427	331	197
RICHLAND	651	0	1,836	1,702	0	131	0	0	0	6	4,329	6	161
ROCK-ISLAND	0	0	0	0	0	0	0	0	62	0	62	42	0
STCLAIR	0	0	2,297	0	0	0	0	0	0	0	2,297	1,091	1,038
SALINE	68	0	1,219	823	0	0	734	1,370	0	14	4,230	519	1,229
SANGAMON	0	0	1,995	3,077	0	0	0	0	4	211	5,288	440	1,522
SCHUYLER	0	0	0	104	607	0	0	0	0	0	712	703	346
SCOTT	0	0	1	0	254	0	0	0	0	0	255	225	95
SHELBY	130	0	3,332	1,957	0	207	0	0	7	87	5,722	87	767
STARK	56	0	466	0	26	0	0	0	0	0	549	521	123
TAZEWELL	4	0	216	458	215	0	0	0	0	0	893	154	143
VERMILION	1,913	0	1,872	0	0	29	0	0	0	0	3,815	647	1,402
WABASH	0	0	899	1,097	0	0	106	787	0	167	3,059	167	294
WARREN	0	0	0	0	346	0	0	0	38	0	384	384	92
WASHINGTON	0	0	3,794	37	0	0	0	0	0	0	3,831	9	1,492
WAYNE	0	0	2,890	2,955	0	0	748	1,363	0	0	7,957	0	155
WHITE	0	0	2,404	2,402	0	0	1,513	1,945	0	0	8,266	0	1,689
WILL	0	0	0	0	13	0	0	0	0	0	13	13	2
WILLIAMSON	55	0	561	888	0	0	671	480	0	52	2,710	619	737
WOODFORD	39	0	43	256	517	0	0	0	0	0	857	0	3
TOTAL	19,136	3,583	78,822	62,771	17,354	9,704	5,924	9,569	1,546	2,992	211,405	22,490	40,696

Note: Figures have been rounded.

1 Assumes recovery rates from accessible demonstrated reserve base of 50% for underground minable reserves and 70% to 85% (depending upon location and thickness) for surface minable reserves.

2 The Seelyville coal of east-central Illinois correlates with the Dekoven and Davis coals of southeastern Illinois.

3 Includes the correlative Litchfield and Assumption Coal Members

channel samples from which all mineral bands (mostly shale and pyrite) more than 3/8 in. thick (1 cm) are excluded. Generally, the coal as mined will have a higher ash and sulfur content; analyses of the coal with average preparation will be similar to that of the channel samples, but somewhat lower in mineral matter and related impurities (e.g. HAPs).

In the tables of analyses following each coal discussion, the ash fusion data are reported from analyses obtained over many years, utilizing different methods and definitions. Therefore, this information should be carefully evaluated before being used.

Rock Island Coal Member - This seam formerly was mined rather extensively in Rock Island, Mercer, and Henry counties, and to a lesser extent in Knox, Fulton, and Warren counties. All production has come from western Illinois. In each mining location, this coal has been found to lie in narrow troughs; its thickness commonly ranged from 49 to 60 in. It is correlated with the Litchfield and Assumption coals, which have been mined at single locations in Montgomery and Christian counties, respectively.

Murphysboro Coal Member - The Murphysboro coal is known with certainty only in Jackson, Perry, and western Williamson counties. In these areas, the coal ranges from about 1 to 7 ft in thickness. The seam has been mined at various places in Jackson County and in western Williamson County.

Near the town of Murphysboro, the coal, reported to be very low in ash and sulfur, was used for making coke. This low- to medium-sulfur coal near Murphysboro occurs beneath thick nonmarine silty gray shales related to an ancient river channel now filled with sandstone. Although the thicker coal near Murphysboro largely is mined out, additional areas of thick coal, ranging from 1.5 to 7.5 ft, have been found in north-central Jackson County and in Perry County. It is probable that additional low- to moderate-sulfur coal more than 4 ft thick will be found in certain areas in Perry, Randolph, and Jackson counties. East and west of the channel, the Murphysboro thins rapidly to less than 1 ft in thickness, except in the area southeast of Carbondale. In 1998, one surface mine began producing again from the coal in northern Jackson County.

Dekoven and Davis Coal Members – The Dekoven and Davis seams commonly are 10 to 25 ft apart. In surface mines producing from these coals, generally both seams have been mined simultaneously. Resources, most too deep for strip mining, are known to occur in Franklin, Williamson, Saline, White, Hamilton, Wabash, Edwards and Gallatin counties. For many years, these coals were mined along their outcrop in small operations and, subsequently, have been surface mined extensively in portions of southern Saline, eastern Williamson, and Gallatin counties. Where mined, the upper coal, the Dekoven, averages 3 to 3.5 ft thick. The lower coal, the Davis, has an average thickness of 3.5 to 4 ft. The Dekoven and Davis coals have been correlated stratigraphically with the Seelyville coal further north and east.

Seelyville Coal Member - The areal extent of the Seelyville coal was not well known until Treworgy completed a study of the seam in 1981, based primarily on geophysical logs. In an area of approximately 1,900 square miles in 10 counties of east-central Illinois, the seam may be as much as 3.5 to 9 ft thick, with estimated in-place resources of about 10 billion tons. Very

Range of typical analyses, Rock Island coal by counties (as-received)

	Henry, Knox, Fulton	Rock Island, Mercer,Warren
Moisture (%)	14-15	16-18
Volatile matter (%)	35-40	35-39
Fixed carbon (%)	36-42	34-39
Ash(%)	7-10	7-10
Sulfur (%)	4-6	3-5
Calorific value(Btu/lb)*	10,700-ll,200	10,400-10,900
Ash fusion (deg F)	1,930-2,370	

*Calorific value of moist coal on a mineral-matter-free basis to the nearest 100 Btu/lb.

Range of typical analyses, Murphysboro coal in Jackson County by district (as-received):

	Murphysboro Dist. West of Du Quoin Monocline	Carbondale Dist. East of Du Quoin Monocline
Moisture (%)	8-10	4-6
Volatile matter (%)	33-35	33-38
Fixed carbon (%)	49-53	46-52
Ash(%)	5-7	9-11
Sulfur (%)	0.6-2	3-5
Calorific value (Btu/lb)*	2,300-12,700	12,400-12,600

*Calorific value of moist coal on a mineral matter-free basis to the nearest 100 Btu/lb.

Range of analyses, Dekoven and Davis coals in Saline County (as-received):

	Dekoven coal	Davis coal
Moisture (%)	5-7	5-7
Volatile matter (%)	35-37	35-37
Fixed carbon (%)	46-48	46-48
Ash(%)	8-13	8-10
Sulfur (%)	3-5	3-4
Calorific value (Btu/lb)*	11,900-12,700	12,500-12,800

*Calorific value of moist coal on a mineral matter-free basis to the nearest 100 Btu/lb.

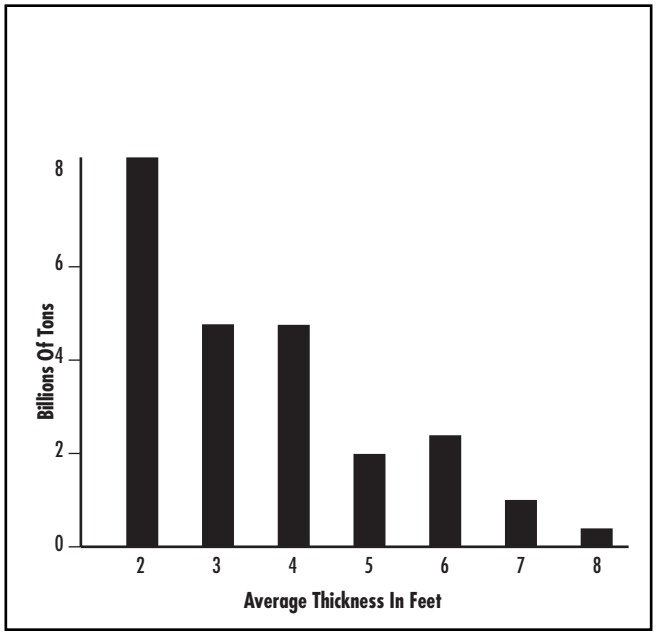


Fig. 5. Strippable coal resources of Illinois by thickness

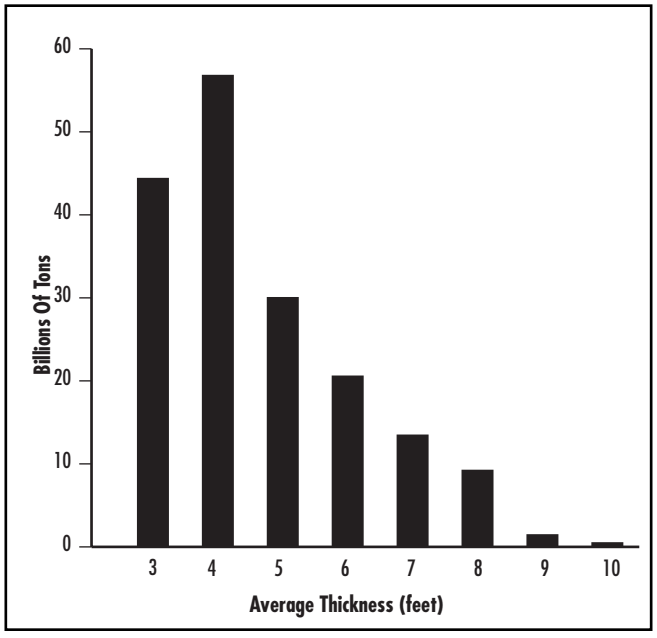


Fig. 6. Underground coal resources of Illinois by thickness b

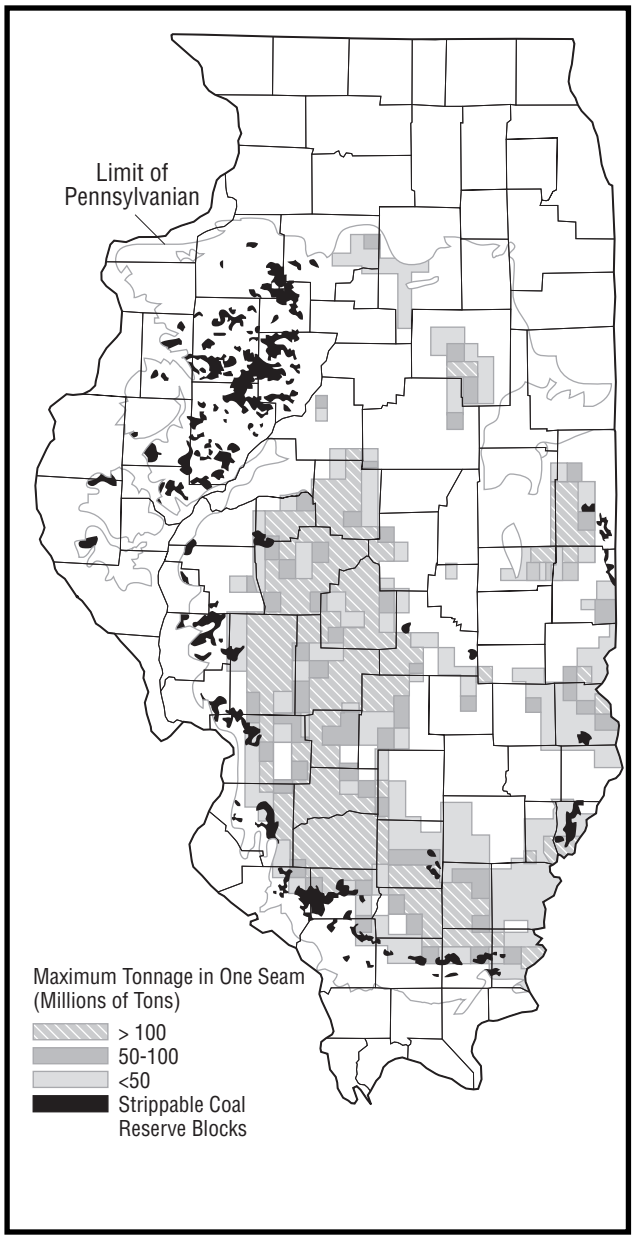
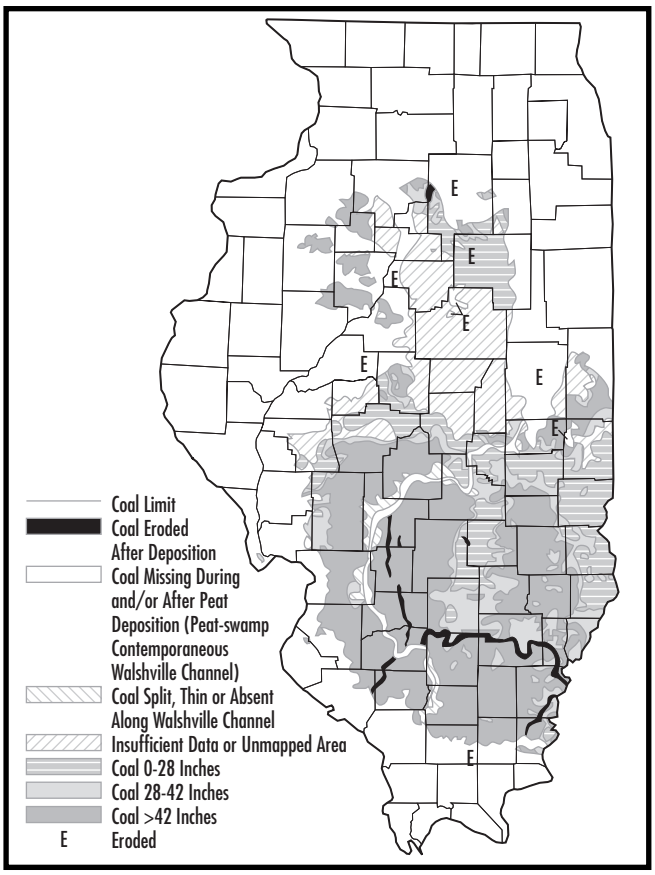


Fig. 7. Townships containing deep-minable and blocks with surface-minable coal with high development potential (based on 1982 and 1978 studies respectively), see Table 4. Underground mines require about 50 to 100 million tons of in-place coal.



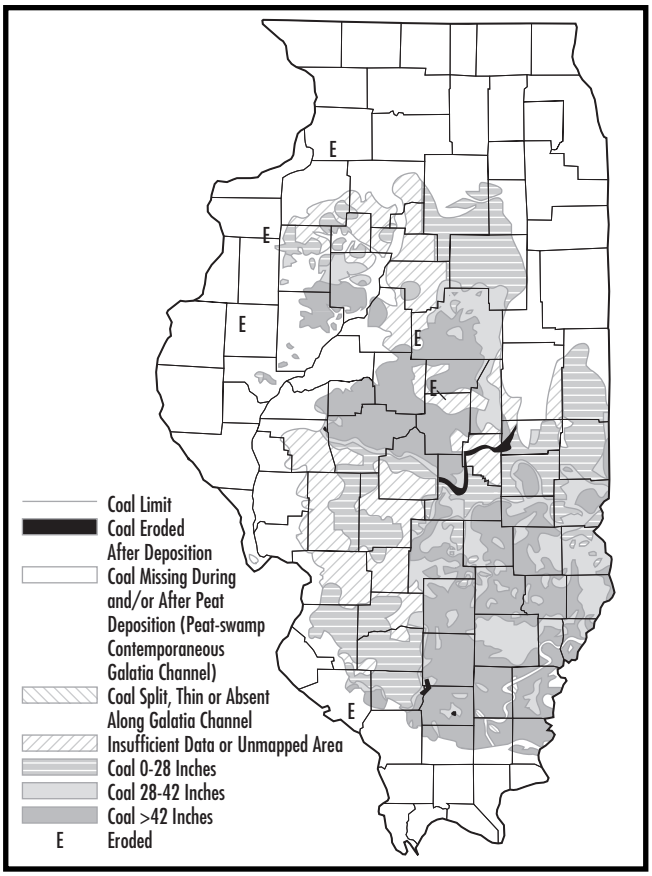


Fig. 9. Generalized thickness of the Springfield Coal

Relatively Low-Sulfur (<2.5% S) Coal Resources in Illinois, As of November 2009 (millions of tons)

Coal	County	Resources	Recoverable Reserves
Herrin			
	Champaign	20	7
	Christian	448	179
	Clark	376	14
	Clinton	95	28
	Coles	1,108	63
	Crawford	41	0
	Cumberland	802	257
	Douglas	987	385
	Edgar	1,533	317
	Franklin	65	18
	Jackson	20	6
	Jefferson	178	56
	Lawrence	110	10
	Macoupin	437	175
	Madison	620	183
	Montgomery	264	79
	Moultrie	271	0
	Perry	46	20
	St. Clair	430	146
	Shelby	567	0
	Vermilion	1,098	416
	Williamson	78	15
	Total	9,596	2,374

Note: About 49 million tons of surface-minable coal of high development potential coal resources with a low to moderate sulfur content (<2.5% S) were identified in the Murphysboro Coal in Jackson County.

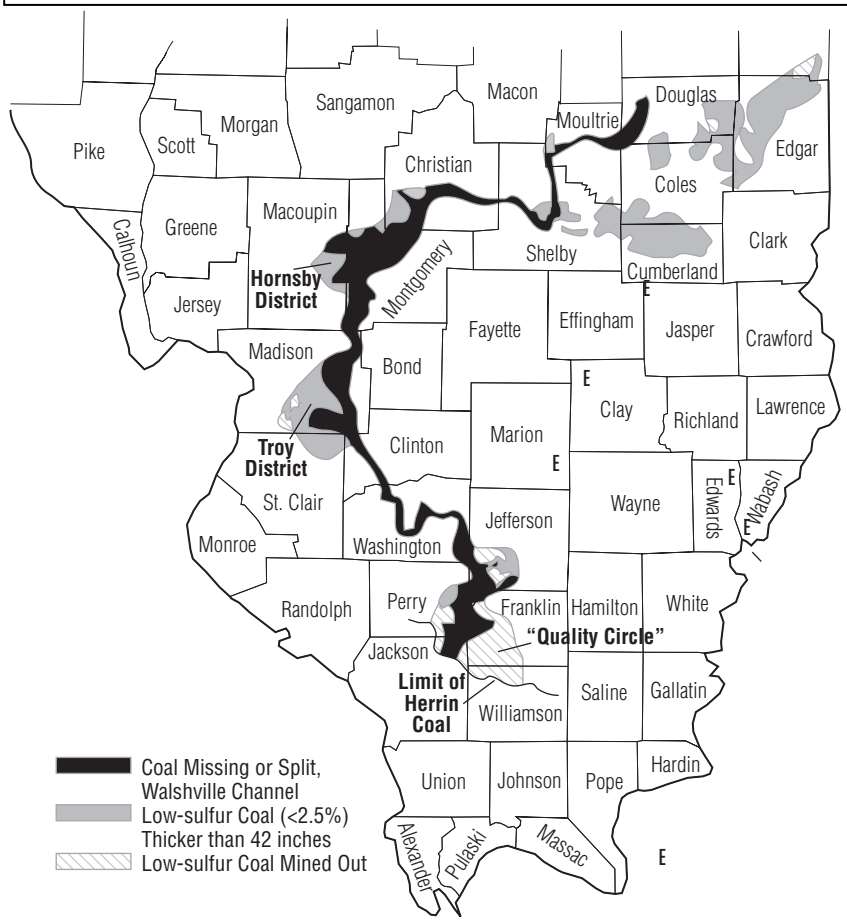


Figure 10: Remaining relatively low-sulfur (<2.5%) resources for the Herrin Coal in Illinois

little is known about seam structure and coal quality. One or more shale partings often can be inferred from the geophysical logs. Sulfur content is probably 3 to 5%. It has been a target for coalbed methane drilling.

Colchester Coal Member - The Colchester seam has been mined principally in northern and western Illinois. Coal thickness is about 42 in. in the La Salle district west of the La Salle Anticlinal Belt (La Salle, Putnam, and Bureau counties); 30 to 40 in. in the Wilmington field (Will, Kankakee, and Grundy counties); 30 to 40 in. in Henry County; and 18 to 30 in. in the southern part of western Illinois. Throughout most of the rest of Illinois, where present, it appears to range from a few inches to less than 24 in. thick.

Range of typical analyses, Colchester coal by counties (as-received):

	La Salle,	Will, Grundy, Woodford, Kankakee	Marshall
Moisture (%)	13-17		13-15
Volatile matter (%)	31-40		34-41
Fixed Carbon (%)	37-48		36-47
Ash(%)	3-9		5-9
Sulfur (%)	1-4		2-3
Caloric value (Btu/lb)*	10,500-11,700		..11,200-11,700
Ash fusion (deg F)	2,140-2,360		

	Bureau, Henry, Knox	Hancock, McDonough
Moisture (%)	14-17	15-19
Volatile matter (%)	36-40	33-40
Fixed Carbon (%)	35-40	38-45
Ash(%)	7-10	5-9
Sulfur (%)	2-4	1-5
Caloricvalue (Btu/lb)*	..10,400-11,200	..10,400-11,200

	McLean
Volatile matter (%)	40-45
Fixed Carbon (%)	36-39
Ash(%)	7-11
Sulfur (%)	2-4
Caloric value (Btu/lb)*	11,200-11,700

*Calorific value of moist coal on a mineral-matter-free basis to the nearest 100 Btu/lb.

Houchin Creek Coal Member - The Houchin Creek [formerly Summum (No. 4)] coal is a relatively unimportant lenticular coal in western Illinois. When present, it usually lies within 2 5 ft below the Springfield seam. The Houchin Creek has been mined near Soperville (Knox County), Summum (Fulton County), Greenville (Greene County), and Jerseyville (Jersey County). The most recent surface mining was near south Wilmington (Kankakee and adjacent Grundy counties), where it was mined in conjunction with the nearby Colchester coal. The Houchin Creek also was surface-mined in southern Illinois near Carrier Mills (Saline County). Although the coal seam is one of the most widely traceable coal horizons in Illinois, it is commonly not of minable thickness.

Range of typical analyses, Houchin Creek coal (as-received):

	Knox County
Moisture (%)	14-16
Volatile matter (%)	37-39
Fixed carbon (%)	38-40
Ash (%)	7-9
Sulfur (%)	3-4
Calorific value (Btu/lb)*	10,800-11,300

*Calorific value of moist coal on a mineral-matter-free basis to the nearest 100 Btu/lb.

Springfield Coal Member - The Springfield coal has been surface-mined extensively in western Illinois. It is the only coal which has been mined in the Springfield district (Sangamon, Logan, and Menard counties of west-central Illinois) and is the most important coal in Saline, Gallatin, Hamilton, and Wabash counties of southeastern Illinois (formerly called Harrisburg (No. 5) coal in this area.) The Springfield also has been mined in southwestern Illinois, principally in Perry, Randolph, Jackson, and Williamson counties. It also formerly was mined as the upper seam in an underground operation at Bloomington (McLean County) and in small mines in Edgar County. One underground mine has been operated in Logan County since 1982 in Area 3.

The Springfield coal has a usual thickness of between 4.5 and 6 ft in most areas where it has been mined. However, relatively thick coal (from 5 to 10 ft) has been mapped in a 4- to 10- mile-wide belt extending from near Mt. Carmel in Wabash County to Harrisburg, Saline County of southeastern Illinois (Figs. 9 and 11). Important resources of relatively low-sulfur coal also occur within this area (Fig. 11) and three underground mines were built here since 1973; one is still in production.

One of the characteristics of the Springfield coal in western Illinois and in the Springfield area (Sangamon, Logan, and Menard counties of west-central Illinois) is the occurrence of fairly numerous claystone dikes ("horsebacks"), which may cut through the coal seam from top to bottom, as well as its roof strata. These irregularities may seriously influence the purity of the coal and they weaken the roof strata.

Range of typical analyses, Springfield coal by counties (as-received):

	Peoria, Logan, Schuyler	Fulton, Tazewell, Sangamon	McLean, Menard,
Moisture (%)	14-18		13-17
Volatile matter (%)	33-38		34-39
Fixed carbon (%)	34-40		35-41
Ash(%)	9-12		9-12
Sulfur (%)	2-4		3-5
Calorific value (Btu/lb)	10,100-10,800		10,400-11,000
Ash fusion (deg 0	1,890-2,270		1,890-2,600

	Macon, Shelby	Edgar
Moisture (%)	12-16	10-12
Volatile matter (%)	34-39	36-40
Fixed carbon (%)	35-40	37-43
Ash(%)	8-12	8-10
Sulfur (%)	3-4	3-4
Calorific value (Btu/lb)*	10,500-11,100	11,200-11,500

	Randolph, Jackson	Perry
Moisture (%)	8-13	8-9
Volatile matter (%)	35-38	35-36
Fixed carbon (%)	40-44	44-55
Ash(%)	9-12	1
Sulfur (%)	4-5	3-4
Calorific value (Btu/lb)*	11,000-11,400	11,600-11,800
Ash fusion (deg F)	2,168-2,174	1,940-2,010

	Gallatin, Saline Williamson	Gallatin (Eagle Valley)
Moisture (%)	5-7	4-5
Volatile matter (%)	33-38	34-37
Fixed carbon (%)	47-53	48-52
Ash (%)	2-5	3-4
Sulfur (%)	2-5	3-4
Calorific value (Btu/lb)*	11,900-12,500	12,400-12,700
Ash fusion (deg F)	2,040-2,090	

*Calorific value of moist coal on a mineral-matter-free basis to the nearest 100 Btu/lb.

Herrin Coal Member - The Herrin coal has been the most extensively mined coal in Illinois, constituting 37% of the total coal resources and almost 58% of the coal in the state deemed to be available for mining. It is the chief source of coal in all of southwestern, southern, and southeastern Illinois, except in the Wabash-Saline-Gallatin County area and the northern part of west-central Illinois and in Vermilion County in eastern Illinois. The Herrin has its lowest ash and sulfur content as well as its greatest thickness in the Jefferson-Franklin-Williamson County district, known as the "Quality Circle" area (Fig. 10). The coal in this area maintains an average thickness in excess of 8 ft. In this area, the Herrin seam has a relatively low sulfur content, ranging from 0.5 to 2.5%, probably averaging about 1.5%. This area of relatively low sulfur and thick coal covers approximately 250 square miles; however, most of the "Quality Circle" has been mined out; only one mine remains active in the area. Other areas that probably have relatively low sulfur consist of an area of several townships in northern St. Clair County and adjacent Madison and Clinton counties (Troy District), and an area of a few townships in eastern Macoupin and adjacent Montgomery and Christian counties (Hornsby District, Fig. 10). Relatively low-sulfur Herrin coal also was mined for many years south of Danville in eastern Vermilion County. Other areas of relatively low-sulfur Herrin coal probably exist in the southern half of the east-central district (Coles, Cumberland,and Shelby Counties).

Relatively Low-Sulfur (<2.5% S) Coal Resources in Illinois, as of November 2009 (millions of tons)

Coal	County	Resources	Recoverable Reserves
Springfield	Edwards	119	20
	Franklin	272	102
	Hamilton	872	363
	Saline	482	177
	Wabash	311	106
	Wayne	225	58
	White	439	179
	Williamson	272	102
	TOTAL	2,992	1,107

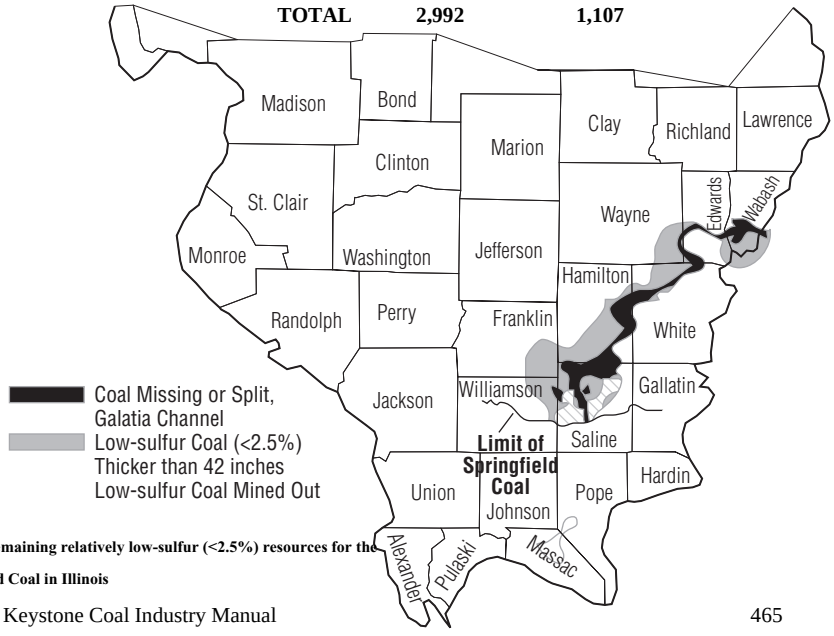


Fig. 11. Remaining relatively low-sulfur (<2.5%) resources for the Springfield Coal in Illinois

The thickness of the Herrin coal in southwestern Illinois generally is between 6 and 8 ft (Fig. 8). In southeastern Illinois, in Saline and Gallatin counties, the Herrin becomes thinner and irregular in thickness. To the north, in the deeper part of the coalfield, it also is irregular in thickness, but does appear to be 6 ft thick or more in some areas.

The Herrin coal of Areas 1-4 is affected by claystone dikes and related disturbances, in particular "white top." The dikes, commonly called "horsebacks," vary in width between fractions of an inch to a few feet and commonly are in the inch to foot-wide range. Many are inclined at variable degrees and associated with mostly small displacements, especially at the top of the coalbed. They generally extend some distance into the roof strata and may thus weaken the roof. "White top" is a mixture of coal and claystone, commonly associated with large clay dikes'; it affects primarily the top 1-3 ft of the coal, but locally may reach down through half or more of the coal seam.

Range of typical analyses, Herrin coal by counties (as-received):

	La Salle, Grundy	Bureau, Stark, Henry, Knox
Moisture (%)	13-16	6-20
Volatile matter (%)	36-41	31-35
Fixed carbon (%)	35-40	37-40
Ash(%)	7-11	8-13
Sulfur (%)	3-5	3-5
Calorific value (Btu/lb)*	10,500-11,400	9,700-10,300
Ash fusion (deg F)	1,950-2,150	1,900-2,120

	Peoria, Fulton	Sangamon, Macoupin
Moisture (%)	15-19	12-16
Volatile matter (%)	32-35	35-40
Fixed carbon (%)	37-43	37-41
Ash(%)	8-13	9-11
Sulfur (%)	2-4	3-5
Calorific value (Btu/lb)*	10,000-10,700	10,400-10,900
Ash fusion (degF).	1,930-2,160	

	Christian, Montgomery, Bond, Madison	Douglas, Vermilion
Moisture (%)	12-14	4-16
Volatile matter (%)	35-40	32-36
Fixed carbon (%)	38-41	38-41
Ash(%)	9-11	8-12
Sulfur (%)	3-5	1-3
Calorific value (Btu/lb)*	10,500-11,000	10,400-11,100
Ash fusion (deg F)	1,920-2,170	2,080-2,220

	Clinton, St. Clair	Marion Washington, Randolph, Perry
Moisture (%)	10-13	8-12
Volatile matter (%)	35-40	35-39
Fixed carbon (%)	37-42	38-44
Ash(%)	9-12	9-13
Sulfur (%)	1-4	1-4
Calorific value (Btu/lb)*	10,000-10,700	10,800-11,300
Ash fusion (deg F)	1,920-2,090	1,920-2,610

*Calorific value of moist coal on a mineral-matter-free basis to the nearest 100 Btu/lb.

Danville Coal Member - The Danville coal has been mined most extensively in the northern part of the Danville area, Vermilion County of east-central Illinois. Recent exploration has shown that fairly large reserves of underground minable Danville coal exist to the west of the extensively mined area in Vermilion County. The Danville has been locally mined in Area 1, in part of the La Salle area and in the vicinity of Sparland in Marshall County. The seam has been reported to attain a minable thickness southeastward in northeastern McLean and adjacent Livingston counties. Recent exploration reportedly has outlined some relatively low-sulfur Danville coal in Clark County of the east-central area; similar conditions may exist in adjacent counties.

Range of typical analyses, Danville coal by counties (as-received):

	Bureau, Marshall	Vermilion
Moisture (%)	15-19	13-17
Volatile matter (%)	33-38	37-39
Fixed carbon (%)	34-38	37-40
Ash(%)	12-15	9-11
Sulfur (%)	3-4	3
Calorific value (Btu/lb)*	9,600-10,300	10,500-11,300
Ash fusion (deg F)	2,040-2,160	1,940-2,180

*Calorific value of moist coal on a mineral-matter-free basis to the nearest 100 Btu/lb.

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*Note: A list of publications related to coal in Illinois is available from the Illinois State Geological Survey, 615 E. Peabody Dr., Champaign, IL 61820 (217-244-2414). The Survey's website, www.isgs.illinois.edu, includes a searchable listing of all of the Survey's publications.

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