

UNITED STATES DEPARTMENT OF THE INTERIOR  
GEOLOGICAL SURVEY

ANALYSES OF ILLINOIS COAL AND ASSOCIATED ROCK SAMPLES  
COLLECTED IN 1975 AND 1976

by  
CHARLES L. OMAN

U. S. Geological Survey Open-File Report 94-555

This report is preliminary and has not been reviewed for  
conformity with U.S. Geological Survey editorial  
standards, and stratigraphic nomenclature.

## Abstract

Chemical and geologic data are presented for 133 samples of coal and coal-associated rocks from Illinois. These data include sample site locations, stratigraphic position, air-drying loss, proximate and ultimate analysis, calorific value, forms of sulfur, initial deformation temperature, softening temperature, fluid temperature, free-swelling index, concentrations of major elements and minor elements reported as oxides, and trace elements.

## Introduction

From 1975 to 1976 members of the Illinois State Geological Survey (ISGS) collected 92 samples of bituminous coal and 41 samples of associated roof, parting, and floor rocks from 16 localities. The samples were collected to generate coal quality data for Illinois coals. These samples were analyzed by the U.S. Geological Survey (USGS) for major-and minor-oxides and trace elements, and by the U.S. Bureau of Mines for standard proximate and ultimate analyses, calorific value, forms of sulfur, ash-fusion temperatures, free-swelling index, and air-drying loss.

The USGS sample numbers, beginning with the letter D (figure 1) were analyzed using a scheme described by Swanson and Huffman (1976). The USGS sample numbers beginning with the letter W were analyzed according to the flow chart in Figure 2. Details on the analytical procedures used in this latter scheme can be found in Golightly and Simon (1989).

The sample locations are plotted in figure 3, and the sample descriptions are given in table 1 for 92 coal samples and in table 1a for 41 rock samples. Tables 1 and 1a include the USGS sample numbers, Illinois State Geological Survey numbers, latitude, longitude, geologic quadrangle name, county, coal bed name; table 1a also includes member, and zone. The samples are arranged

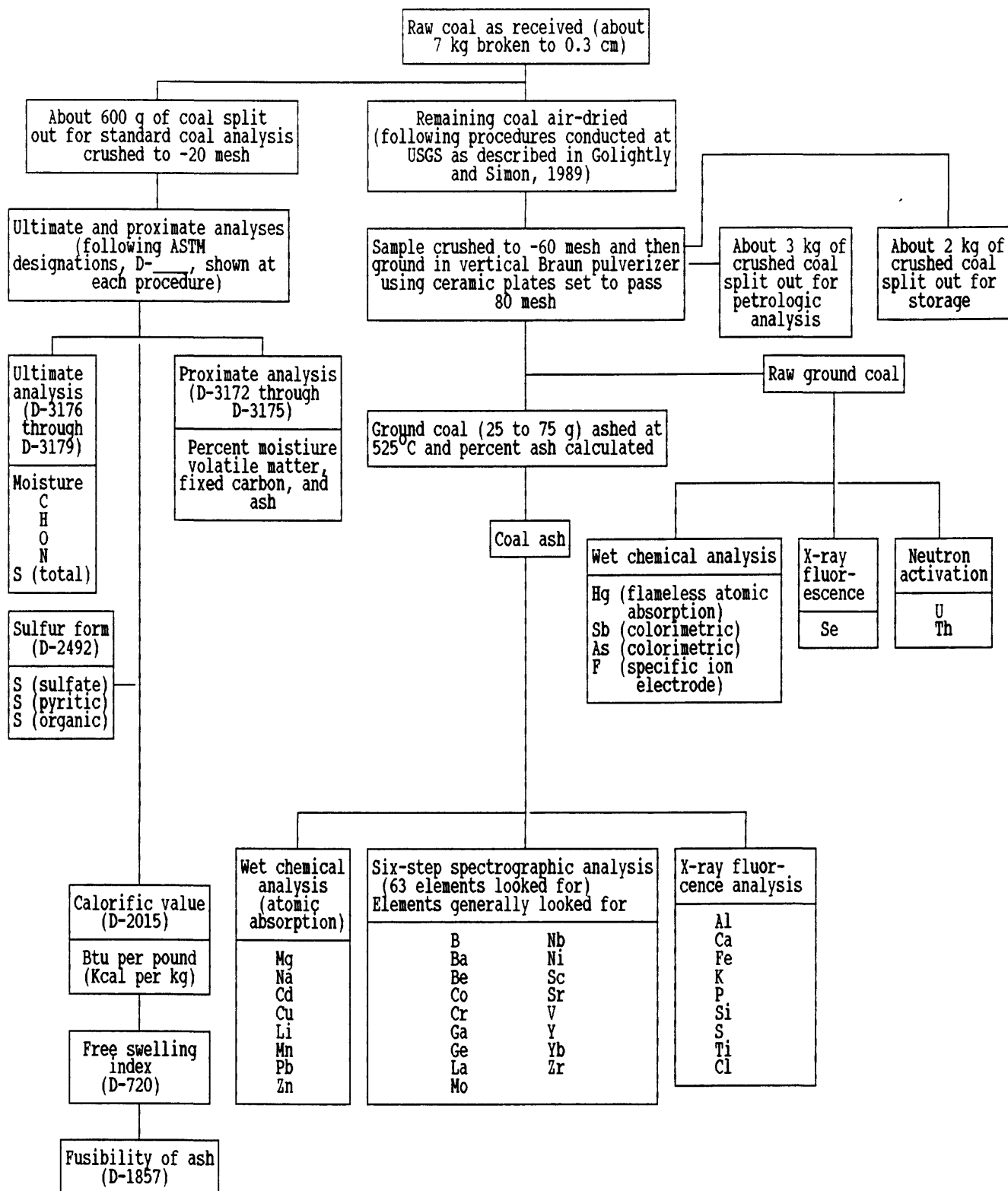


Figure 1. Flow diagram of procedures used for D samples, for the analysis of coal samples collected. (ASTM-American Society for Testing and Materials, USGS-United States Geological Survey.)

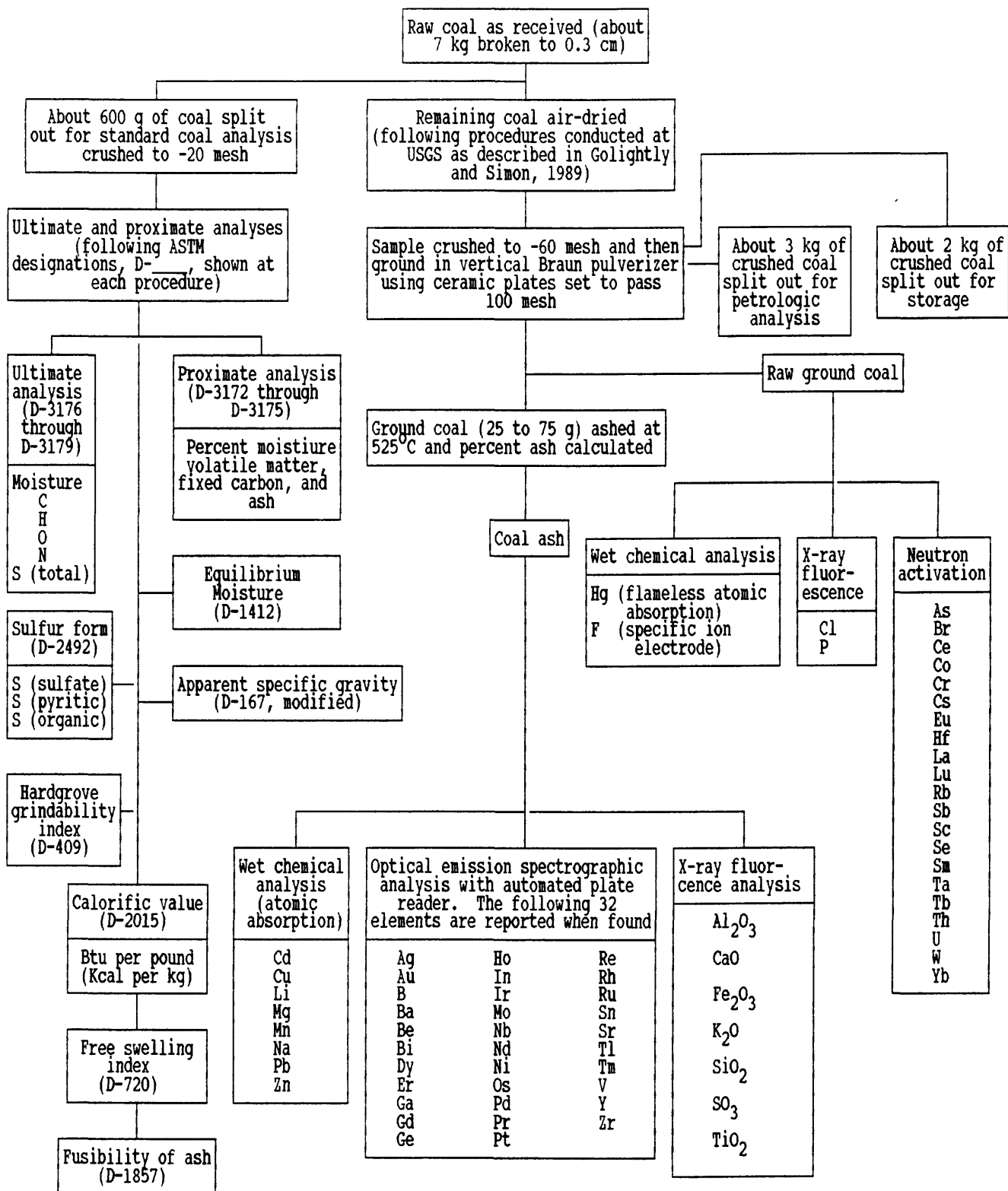


Figure 2. Flow diagram of procedures used for W samples, for the analysis of coal samples collected. (ASTM-American Society for Testing and Materials, USGS-United States Geological Survey.)

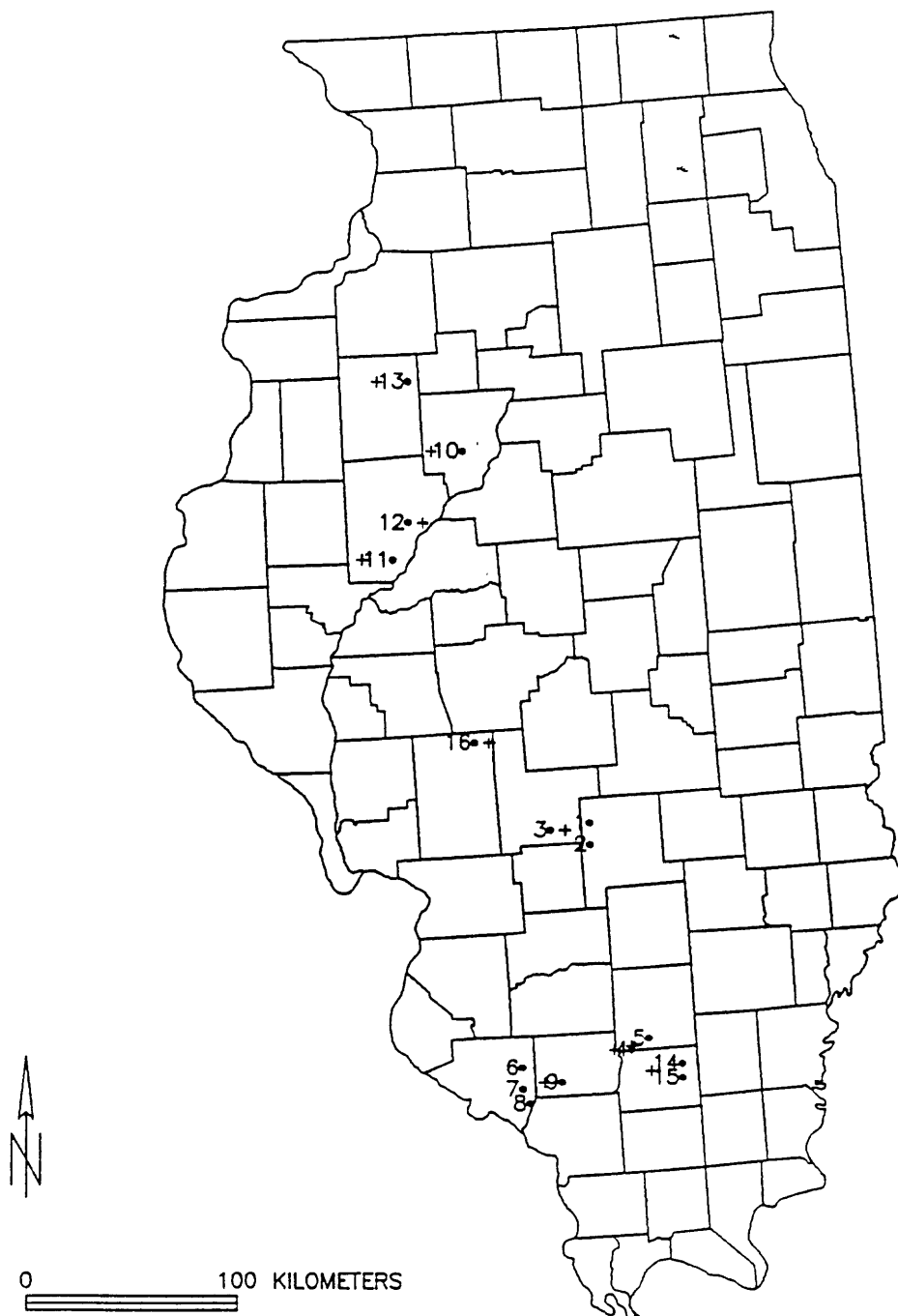


Figure 3. Sketch depicting sample localities in Illinois.

by county and sample locality.

The analytical results are shown in Tables 3, 4, and 5. Table 3 contains the major- and minor-oxides on an ash basis. Table 4 contains the trace element concentrations on a whole-coal basis. Table 5 contains data from ultimate and proximate analyses, calorific value, forms of sulfur, free-swelling index and ash-fusion temperatures. Tables 3, 4 and 5 contain coal data; Tables 3a and 4a contain data on the associated rocks.

Table 5 contains arithmetic means, minimums, and maximums for the Illinois samples identified as coal. A weighted average, (mathematically derived using bed thickness) was determined to provide a single channel sample for each location; for comparison the arithmetic means for the Illinois data published by Gluskoter and others (1977) are listed. The higher sulfate sulfur and lower calorific value are inferred to be the result of weathering or a longer storage time before the samples were analyzed.

## References

- Gluskoter, H.J., Ruch, R.R., Miller, W.G., Cahill, R.A., Dreher, G.B., and Kuhn, J.K., 1977, Trace elements in coal: occurrence and distribution: Illinois State Geological Survey Circular 499, 154 p.
- Golightly, D.W., and Simon, F.O., 1989, Methods for sampling and inorganic analysis of coal: U.S. Geological Survey Bulletin 1823, 72 p.
- Swanson, V.E., and Huffman, Claude, Jr., 1976, Guidelines for sample collecting and analytical methods used in the U.S. Geological Survey for determining chemical composition of coal: U.S. Geological Survey Circular. 735, 11 p.

## References

- Gluskoter, H.J., Ruch, R.R., Miller, W.G., Cahill, R.A., Dreher, G.B., and Kuhn, J.K., 1977, Trace elements in coal: occurrence and distribution: Illinois State Geological Survey Circular 499, 154 p.
- Golightly, D.W., and Simon, F.O., 1989, Methods for sampling and inorganic analysis of coal: U.S. Geological Survey Bulletin 1823, 72 p.
- Swanson, V.E., and Huffman, Claude, Jr., 1976, Guidelines for sample collecting and analytical methods used in the U.S. Geological Survey for determining chemical composition of coal: U.S. Geological Survey Circular. 735, 11 p.



Table 1. Sample location information for USCHEM data for 92 coal bench samples from Illinois.  
[nde means no data entered.]

USGS N.	IGS N.	Latitude	Longitude	Quadrangle (7.5')	County	Bed	Thickness in.
SITE 1							
D176941	L00889	390505N	892050W	FILMORE	MONTGOMERY	HERRIN NO 6	3.5
D176942	L00890	390505N	892050W	FILMORE	MONTGOMERY	HERRIN NO 6	17
D176943	L00891	390505N	892050W	FILMORE	MONTGOMERY	HERRIN NO 6	15.5
D176944	L00892	390505N	892050W	FILMORE	MONTGOMERY	HERRIN NO 6	12
D176945	L00893	390505N	892050W	FILMORE	MONTGOMERY	HERRIN NO 6	22.5
D176946	L00895	390505N	892050W	FILMORE	MONTGOMERY	HERRIN NO 6	15
SITE 2							
D176947	L00898	390505N	892045W	FILMORE	MONTGOMERY	HERRIN NO 6	4
D176948	L00899	390505N	892045W	FILMORE	MONTGOMERY	HERRIN NO 6	9
D176949	L00900	390505N	892045W	FILMORE	MONTGOMERY	HERRIN NO 6	19
D176950	L00901	390505N	892045W	FILMORE	MONTGOMERY	HERRIN NO 6	13
D176951	L00902	390505N	892045W	FILMORE	MONTGOMERY	HERRIN NO 6	12
D176952	L00903	390505N	892045W	FILMORE	MONTGOMERY	HERRIN NO 6	14
D176953	L00905	390505N	892045W	FILMORE	MONTGOMERY	HERRIN NO 6	14
SITE 3							
D176954	L00908	390502N	892048W	FILMORE	MONTGOMERY	HERRIN NO 6	14
D176955	L00909	390502N	892048W	FILMORE	MONTGOMERY	HERRIN NO 6	25
D176956	L00910	390502N	892048W	FILMORE	MONTGOMERY	HERRIN NO 6	22
D176957	L00912	390502N	892048W	FILMORE	MONTGOMERY	HERRIN NO 6	22
SITE 4							
D176958	L00915	380808N	890930W	TAMAROA	JEFFERSON	HERRIN NO 6	12
D176959	L00916	380808N	890930W	TAMAROA	JEFFERSON	HERRIN NO 6	10
D176960	L00918	380808N	890930W	TAMAROA	JEFFERSON	HERRIN NO 6	25
D176961	L00919	380808N	890930W	TAMAROA	JEFFERSON	HERRIN NO 6	24
D176962	L00920	380808N	890930W	TAMAROA	JEFFERSON	HERRIN NO 6	26
D176963	L00921	380808N	890930W	TAMAROA	JEFFERSON	HERRIN NO 6	12
D176964	L00922	380808N	890930W	TAMAROA	JEFFERSON	HERRIN NO 6	8
SITE 5							
D176965	L00925	380850N	890350W	WALTONVILLE	JEFFERSON	HERRIN NO 6	4
D176966	L00926	380850N	890350W	WALTONVILLE	JEFFERSON	HERRIN NO 6	15
D176967	L00927	380850N	890350W	WALTONVILLE	JEFFERSON	HERRIN NO 6	24
D176968	L00928	380850N	890350W	WALTONVILLE	JEFFERSON	HERRIN NO 6	39
D176969	L00929	380850N	890350W	WALTONVILLE	JEFFERSON	HERRIN NO 6	16
D176970	L00931	380850N	890350W	WALTONVILLE	JEFFERSON	HERRIN NO 6	21
SITE 6							
W189298	L00986	380059N	893312W	PERCY	PERRY	SPRINGFIELD NO 5	10
W189299	L00987	380059N	893312W	PERCY	PERRY	SPRINGFIELD NO 5	11
W189300	L00988	380059N	893312W	PERCY	PERRY	SPRINGFIELD NO 5	13
W189301	L00989	380059N	893312W	PERCY	PERRY	SPRINGFIELD NO 5	18.5
W189302	L00990	380059N	893312W	PERCY	PERRY	SPRINGFIELD NO 5	5
SITE 7							
W189303	L00993	380101N	893305W	PERCY	PERRY	HERRIN NO 6	13.5
W189304	L00994	380101N	893305W	PERCY	PERRY	HERRIN NO 6	1
W189305	L00995	380101N	893305W	PERCY	PERRY	HERRIN NO 6	14
W189306	L00996	380101N	893305W	PERCY	PERRY	HERRIN NO 6	1.5
W189307	L00997	380101N	893305W	PERCY	PERRY	HERRIN NO 6	12
W189308	L00998	380101N	893305W	PERCY	PERRY	HERRIN NO 6	23.5
W189309	L01000	380101N	893305W	PERCY	PERRY	HERRIN NO 6	2
SITE 8							
W189310	L01003	380101N	893307W	PERCY	PERRY	HERRIN NO 6	10
W189311	L01004	380101N	893307W	PERCY	PERRY	HERRIN NO 6	26
W189312	L01005	380101N	893307W	PERCY	PERRY	HERRIN NO 6	25
W189313	L01007	380101N	893307W	PERCY	PERRY	HERRIN NO 6	12

Table 1. Sample location information for USCHEM data for 92 coal bench samples from Illinois.--Continued  
[nde means no data entered.]

USGS N.	IGS N.	Latitude	Longitude	Quadrangle (7.5')	County	Bed	Thickness in.
SITE 9							
W189314	L01010	380101N	893309W	PERCY	PERRY	HERRIN NO 6	16
W189315	L01011	380101N	893309W	PERCY	PERRY	HERRIN NO 6	11.5
W189316	L01012	380101N	893309W	PERCY	PERRY	HERRIN NO 6	6
W189317	L01013	380101N	893309W	PERCY	PERRY	HERRIN NO 6	18
W189318	L01014	380101N	893309W	PERCY	PERRY	HERRIN NO 6	10.5
W189319	L01016	380101N	893309W	PERCY	PERRY	HERRIN NO 6	10
SITE 10							
W191079	L01193	404400N	895640W	FARMINGTON EAST	PEORIA	HERRIN NO 6	10
W191080	L01194	404400N	895640W	FARMINGTON EAST	PEORIA	HERRIN NO 6	4
W191081	L01195	404400N	895640W	FARMINGTON EAST	PEORIA	HERRIN NO 6	8
W191082	L01196	404400N	895640W	FARMINGTON EAST	PEORIA	HERRIN NO 6	7
W191083	L01197	404400N	895640W	FARMINGTON EAST	PEORIA	HERRIN NO 6	12
W191084	L01198	404400N	895640W	FARMINGTON EAST	PEORIA	HERRIN NO 6	7
SITE 11							
W191085	L01149	401730N	902230W	IPAFA	FULTON	COLCHESTER	6
W191086	L01150	401730N	902230W	IPAFA	FULTON	COLCHESTER	7
W191087	L01151	401730N	902230W	IPAFA	FULTON	COLCHESTER	7
W191089	L01152	401730N	902230W	IPAFA	FULTON	COLCHESTER	8
SITE 12							
W191088	L01185	402600N	900100W	ST DAVID	FULTON	SPRINGFIELD NO 5	8
W191090	L01186	402600N	900100W	ST DAVID	FULTON	SPRINGFIELD NO 5	8
W191091	L01187	402600N	900100W	ST DAVID	FULTON	SPRINGFIELD NO 5	8
W191092	L01188	402600N	900100W	ST DAVID	FULTON	SPRINGFIELD NO 5	8
W191093	L01189	402600N	900100W	ST DAVID	FULTON	SPRINGFIELD NO 5	8
W191094	L01190	402600N	900100W	ST DAVID	FULTON	SPRINGFIELD NO 5	8
SITE 13							
W191095	L01170	410230N	901345W	ONEIDA	KNOX	HERRIN NO 6	8
W191096	L01171	410230N	901345W	ONEIDA	KNOX	HERRIN NO 6	8
W191097	L01172	410230N	901345W	ONEIDA	KNOX	HERRIN NO 6	8
W191098	L01173	410230N	901345W	ONEIDA	KNOX	HERRIN NO 6	8
W191099	L01174	410230N	901345W	ONEIDA	KNOX	HERRIN NO 6	8
W191100	L01191	410230N	901345W	ONEIDA	KNOX	HERRIN NO 6	8
SITE 14							
W192923	L01423	380206N	885754W	REND LAKE DAM	FRANKLIN	HERRIN NO 6	6
W192924	L01424	380206N	885754W	REND LAKE DAM	FRANKLIN	HERRIN NO 6	8
W192925	L01425	380206N	885754W	REND LAKE DAM	FRANKLIN	HERRIN NO 6	21
W192926	L01426	380206N	885754W	REND LAKE DAM	FRANKLIN	HERRIN NO 6	20
W192927	L01427	380206N	885754W	REND LAKE DAM	FRANKLIN	HERRIN NO 6	27
W192928	L01428	380206N	885754W	REND LAKE DAM	FRANKLIN	HERRIN NO 6	11
SITE 15							
W192929	L01431	380206N	885748W	REND LAKE DAM	FRANKLIN	HERRIN NO 6	9
W192930	L01432	380206N	885748W	REND LAKE DAM	FRANKLIN	HERRIN NO 6	21
W192931	L01433	380206N	885748W	REND LAKE DAM	FRANKLIN	HERRIN NO 6	16
W192932	L01434	380206N	885748W	REND LAKE DAM	FRANKLIN	HERRIN NO 6	16
W192933	L01435	380206N	885748W	REND LAKE DAM	FRANKLIN	HERRIN NO 6	17
W192934	L01437	380206N	885748W	REND LAKE DAM	FRANKLIN	HERRIN NO 6	16
SITE 16							
W192935	L01445	392839N	894336W	FARMERSVILLE	MACOUP IN	HERRIN NO 6	21
W192936	L01446	392839N	894336W	FARMERSVILLE	MACOUP IN	HERRIN NO 6	11
W192937	L01447	392839N	894336W	FARMERSVILLE	MACOUP IN	HERRIN NO 6	12
W192938	L01448	392839N	894336W	FARMERSVILLE	MACOUP IN	HERRIN NO 6	21
W192939	L01450	392839N	894336W	FARMERSVILLE	MACOUP IN	HERRIN NO 6	20
W192940	L01451	392839N	894336W	FARMERSVILLE	MACOUP IN	HERRIN NO 6	12

Table 1a. Sample location information for USCHEM data for 41 coal associated-rock samples from Illinois.  
[NDE mean no data entered.]

USGS N.	ISGS N.	Latitude	Longitude	Quadrangle (7.5')	County	Bed	Member	Zone	Thickness in.
SITE 1									
D176926	L00888	390505N	892050W	FILMORE	MONTGOMERY	HERRIN NO 6	ANNA SHALE	ROOF	4
D176927	L00894	390505N	892050W	FILMORE	MONTGOMERY	HERRIN NO 6	BLUE BAND	NDE	1.5
D176928	L00896	390505N	892050W	FILMORE	MONTGOMERY	HERRIN NO 6	NDE	NDE	4
SITE 2									
D176929	L00897	390505N	892045W	FILMORE	MONTGOMERY	HERRIN NO 6	BRERETON LS	ROOF	4
D176930	L00904	390505N	892045W	FILMORE	MONTGOMERY	HERRIN NO 6	BLUE BAND	NDE	1
D176931	L00906	390505N	892045W	FILMORE	MONTGOMERY	HERRIN NO 6	NDE	NDE	4
SITE 3									
D176932	L00907	390502N	892048W	FILMORE	MONTGOMERY	HERRIN NO 6	JAMESTOWN LS	ROOF	4
D176933	L00911	390502N	892048W	FILMORE	MONTGOMERY	HERRIN NO 6	BLUE BAND	NDE	1
D176934	L00913	390502N	892048W	FILMORE	MONTGOMERY	HERRIN NO 6	NDE	NDE	4
SITE 4									
D176935	L00914	380808N	890930W	TAMAROA	JEFFERSON	HERRIN NO 6	ENERGY SHALE	ROOF	4
D176936	L00917	380808N	890930W	TAMAROA	JEFFERSON	HERRIN NO 6	NDE	PARTING	1.5
D176937	L00923	380808N	890930W	TABAROA	JEFFERSON	HERRIN NO 6	NDE	NDE	4
SITE 5									
D176938	L00924	380850N	890350W	WALTONVILLE	JEFFERSON	HERRIN NO 6	ENERGY SHALE	ROOF	4
D176939	L00930	380850N	890350W	WALTONVILLE	JEFFERSON	HERRIN NO 6	BLUE BAND	NDE	2
D176940	L00932	380850N	890350W	WALTONVILLE	JEFFERSON	HERRIN NO 6	NDE	NDE	4
SITE 6									
W189324	L00985	380059N	893312W	PERCY	PERRY	SPRINGFIELD NO 5	NDE	ROOF	6
W189325	L00991	380059N	893312W	PERCY	PERRY	SPRINGFIELD NO 5	NDE	UNDERCLAY	5.5
SITE 7									
W189326	L00992	380101N	893305W	PERCY	PERRY	HERRIN NO 6	ANNA SHALE	ROOF	4
W189327	L00999	380101N	893305W	PERCY	PERRY	HERRIN NO 6	BLUE BAND	PARTING	1
W189328	L01001	380101N	893305W	PERCY	PERRY	HERRIN NO 6	NDE	FLOOR	4
SITE 8									
W189329	L01002	380101N	893307W	PERCY	PERRY	HERRIN NO 6	ENERGY SHALE	ROOF	4
W189330	L01006	380101N	893307W	PERCY	PERRY	HERRIN NO 6	BLUE BAND	PARTING	12
W189331	L01008	380101N	893307W	PERCY	PERRY	HERRIN NO 6	NDE	FLOOR	4
SITE 9									
W189332	L01009	380101N	893309W	PERCY	PERRY	HERRIN NO 6	BRERETON LS	ROOF	4
W189333	L01045	380101N	893309W	PERCY	PERRY	HERRIN NO 6	ANNA SHALE	ROOF	0
W189334	L01015	380101N	893309W	PERCY	PERRY	HERRIN NO 6	BLUE BAND	PARTING	2
W189335	L01017	380101N	893309W	PERCY	PERRY	HERRIN NO 6	NDE	FLOOR	4
SITE 10									
W191101	L01192	404400N	895640W	FARMINGTON EAST	PEORIA	HERRIN NO 6	NDE	ROOF	6
W191102	L01199	404400N	895640W	FARMINGTON EAST	PEORIA	HERRIN NO 6	NDE	UNDERCLAY	5
SITE 11									
W191103	L01147	401730N	902230W	IPAFA	FULTON	COLCHESTER	NDE	ROOF	10
W191104	L01148	401730N	902230W	IPAFA	FULTON	COLCHESTER	NDE	UNDERCLAY	4
SITE 12									
No coal associated samples.									
SITE 13									
W191105	L01177	410230N	901345W	ONEIDA	KNOX	HERRIN NO 6	NDE	PARTING	0
W191106	L01178	410230N	901345W	ONEIDA	KNOX	HERRIN NO 6	NDE	PARTING	0
SITE 14									
W194841	L01422	380206N	885754W	REND LAKE DAM	FRANKLIN	HERRIN NO 6	NDE	ROOF	4
W194842	L01429	380206N	885754W	REND LAKE DAM	FRANKLIN	HERRIN NO 6	NDE	FLOOR	4
SITE 15									
W194843	L01430	380206N	885748W	REND LAKE DAM	FRANKLIN	HERRIN NO 6	NDE	ROOF	4
W194844	L01438	380206N	885748W	REND LAKE DAM	FRANKLIN	HERRIN NO 6	NDE	FLOOR	4
W194847	L01436	380206N	885748W	REND LAKE DAM	FRANKLIN	HERRIN NO 6	NDE	PARTING	18
SITE 16									
W194845	L01444	392839N	894336W	FARMERSVILLE	MACOUPIN	HERRIN NO 6	NDE	ROOF	0
W194846	L01452	392839N	894336W	FARMERSVILLE	MACOUPIN	HERRIN NO 6	NDE	FLOOR	0
W194848	L01449	392839N	894336W	FARMERSVILLE	MACOUPIN	HERRIN NO 6	NDE	PARTING	.6

Table 2.--Major- and minor- oxide composition of the laboratory ash of 92 coal bench samples from Illinois.

[Values in percent. Coal ashed at 525°C. L means less than the value shown B, not determined. Sample number is USGS laboratory number. ]

Sample Number	Ash	SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	CaO	MgO	Na <sub>2</sub> O	MnO	K <sub>2</sub> O	Fe <sub>2</sub> O <sub>3</sub>	TiO <sub>2</sub>	P <sub>2</sub> O <sub>5</sub>	SO <sub>3</sub>
SITE 1												
D176941	5.2	19	11	12	0.48	1.55	0.05	2	23	2.2	5.7	15
D176942	6.4	41	15	2.5	0.7	1.82	0.04	1.6	19	1.6	1 L	6.6
D176943	10	32	14	4.6	0.46	1.35	0.06	0.88	31	1.7	1 L	6.9
D176944	14	30	14	2.2	0.55	1.08	0.04	1.2	34	0.65	1 L	4.4
D176945	13.4	54	21	2.9	0.91	1.39	0.04	2.1	10	1	1 L	3.3
D176946	12	27	13	3.7	0.53	1.15	0.06	1.1	42	0.59	1 L	6.1
SITE 2												
D176947	15.8	44	15	6.6	1.3	1.26	0.11	2.5	12	1.1	1 L	8.2
D176948	8.8	25	11	11	0.65	1.42	0.15	1.3	26	0.54	1 L	9.9
D176949	10.9	29	12	10	0.47	1.15	0.12	0.81	31	0.51	1 L	9.3
D176950	16.3	51	19	3.7	0.58	1.2	0.04	1.5	17	1.3	1 L	3.8
D176951	11.5	45	18	5	0.79	1.49	0.06	1.8	12	0.85	1 L	6.3
D176952	16.8	47	17	3	0.76	1.05	0.04	1.7	18	0.86	1 L	4.7
D176953	15.5	28	12	6.9	0.5	0.98	0.11	0.97	28	0.71	1 L	9.8
SITE 3												
D176954	8.8	40	16	11	0.8	1.76	0.21	1.6	5	1.4	1 L	13
D176955	9.8	35	18	6	0.62	1.95	0.08	1.4	14	1.6	1 L	9.5
D176956	12.2	45	21	4.7	0.93	1.9	0.07	2.1	10	0.98	1 L	5.5
D176957	12	31	17	1.5	0.58	1.26	0.03	1.2	34	0.72	1 L	3.3
SITE 4												
D176958	11.3	38	20	0.78	1.53	1.86	0.03	3.5	18	0.78	1 L	4.9
D176959	12.3	45	23	0.88	1.18	1.3	0.02	3.6	19	0.81	1 L	3.7
D176960	20.8	45	22	3.1	1	1	0.03	3.4	14	0.96	1 L	6
D176961	11.1	43	23	0.47	1	1.88	0.01	2.5	16	0.96	1 L	2.6
D176962	16.8	58	26	0.17	1.22	1.43	0.01	2.9	4.6	1.1	1 L	1.4
D176963	7.1	38	20	8.2	1.02	2.37	0.12	1.8	3.3	0.75	1 L	8.7
D176964	9.6	39	18	8.1	1.15	1.22	0.13	2.5	4.7	0.76	1 L	8.6
SITE 5												
D176965	2.8		B	B	1.25	4.55	0.13		B		B	B
D176966	5.3	24	16	14	3.13	2.86	0.36	1.5	12	0.65	1 L	17
D176967	4.4	46	31	2.4	0.84	3.4	0.03	2.3	4.6	1.2	1 L	3.9
D176968	7.6	36	24	9.4	0.89	2.17	0.13	1.6	1.8	0.98	1 L	8.2
D176969	12.1	52	27	1	1.09	1.33	0.03	2.3	1.9	1.2	1 L	1.9
D176970	8.3	44	23	5	0.97	1.77	0.08	1.7	5.6	0.92	1 L	6.2
SITE 6												
W189298	11.5	49	17	1.5	0.66	0.95	0.02	1.9	16	0.82	1 L	1.3
W189299	7.7	25	11	8.3	0.32	0.55	0.02	0.42	28	0.45	1 L	3.7
W189300	11.6	26	15	4.1	0.32	0.57	0.02	1.1	48	0.85	1 L	3.6
W189301	12.6	36	12	3.8	0.66	0.78	0.02	1.4	27	0.6	1 L	2
W189302	16.2	56	16	3.4	1.16	0.72	0.04	2.3	6.9	0.84	1 L	1.7

Table 2.—Major- and minor- oxide composition of the laboratory ash of 92 coal bench samples from Illinois.—Continued

Sample Number	Ash	SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	CaO	MgO	Na <sub>2</sub> O	MnO	K <sub>2</sub> O	Fe <sub>2</sub> O <sub>3</sub>	TiO <sub>2</sub>	P <sub>2</sub> O <sub>5</sub>	SO <sub>3</sub>
SITE 7												
W189303	7.2	37	19	3.2	0.9	0.81	0.02	2.4	29	0.9	1 L	4.4
W189304	20.5	5.2	2.7	1.3	0.2	0.19	0.01	0.03 L	75	0.07 L	1 L	3
W189305	5.5	48.6	20.3	6.5	0.71	1.08	0.02	1.7	12.3	1	0.03	2.2
W189306	25.4	59	25	0.71	1.1	1.89	0.01	1.5	4.7	1.2	1 L	0.35
W189307	11.2	38	17	3.9	0.28	0.59	0.02	1.3	21	0.72	1 L	1.6
W189308	12.6	53	20	2.1	1.05	0.68	0.02	2.4	8.7	0.92	1 L	0.96
W189309	14	23	11	7.5	0.42	0.36	0.05	0.69	43	0.43	1 L	6.3
SITE 8												
W189310	7	34	14	3.5	0.83	0.7	0.02	1.9	25	0.65	1 L	3
W189311	10.4	33	14	15	0.58	0.61	0.04	1.1	8	0.58	1 L	7.1
W189312	12.4	51	20	4.4	0.85	1.08	0.03	2	7.7	0.91	1 L	1.9
W189313	11.6	30	14	4.2	0.5	0.47	0.02	0.99	38	0.67	1 L	3.9
SITE 9												
W189314	7.4	41	16	6.3	1.13	0.84	0.03	2.3	13	0.79	1 L	4
W189315	7.4	41	17	7	0.51	0.74	0.02	1	12	0.7	1 L	2.3
W189316	10	47	21	3.1	0.71	0.99	0.02	1.7	10	0.97	1 L	2.5
W189317	15.4	51	21	1.6	0.63	0.69	0.02	2.4	9.6	0.97	1 L	1.4
W189318	16.4	46	16	1.4	0.68	0.43	0.01	2	18	0.75	1 L	1.4
W189319	14.8	31	13	4.3	0.35	0.47	0.02	1.1	37	0.53	1 L	3.1
SITE 10												
W191079	7	42.6	19.2	7	1.25	1.35	0.09	2.4	20.1	0.9	0.08	2.9
W191080	9.2	41.2	18.4	9.2	0.9	1	0.12	1.9	19.5	0.8	0.03	2.6
W191081	8.1	47.2	21.6	3.3	0.76	1.01	0.04	1.6	20.7	1	0.04	2.1
W191082	4.8	28.4	19.5	2.1	0.43	1.16	0.04	0.4	42.1	0.6	0.02	2.5
W191083	10.6	43.2	24.8	3.4	0.83	1.05	0.04	1.8	19.5	1.2	0.1	1.8
W191084	18.7	50.1	23	1.7	1.56	0.7	0.03	2.7	19	1.1	0.02	1.7
SITE 11												
W191085	6.6	21.7	12.1	7.5	0.33	0.76	0.06	0.9	42.3	0.6	0.3	2.9
W191086	6.7	21	11.7	7.7	0.43	0.53	0.06	0.9	47.2	0.6	0.2	3
W191087	6.7	22.3	8.6	6.9	0.66	1.05	0.07	0.6	42.4	0.4	0.05	1.1
W191089	5	25.5	14.6	0.7	0.43	0.95	0.03	1.1	53.1	0.7	0.05	2.4
SITE 12												
W191088	11.1	58.9	14.6	11.3	0.65	0.57	0.08	0.7	2.1	0.8	0.1	2.6
W191090	9.8	42.8	13	16	0.46	0.59	0.15	1.1	3.4	0.7	0.02	2.7
W191091	14.2	45.5	12.3	15.4	0.83	0.66	0.14	1.6	9.7	0.6	0.08	4.2
W191092	14.8	36.4	11	7.6	0.6	0.78	0.08	1.4	35.5	0.6	0.02	2.6
W191093	14.9	49.9	14.7	18	0.85	0.7	0.17	1.8	10.6	0.6	0.04	3.5
W191094	16.6	49	11.8	16.5	0.75	0.57	0.18	1.6	7	0.6	0.3	3.9
SITE 13												
W191095	10.9	24.6	12.3	6.4	0.9	0.54	0.06	1.6	23.6	0.7	0.1	2.7
W191096	7.8	41	19.3	5.1	1.05	0.68	0.05	1.7	27.7	1	0.5	2.9
W191097	6.3	21.1	15.9	16.5	0.56	1	0.12	0.4	17.3	0.4	0.1	3.7
W191098	63	49.7	26.6	3	1.46	0.76	0.01	1.8	4.2	1.4	0.07	2
W191099	22.4	53.7	27.2	0.9	0.88	0.85	0.03	1.8	4.2	1.4	0.04	1.7
W191100	20.3	23.6	11.5	7.1	1.34	0.95	0.04	1.3	45.4	0.5	0.1	2.9

Table 2.--Major- and minor- oxide composition of the laboratory ash of 92 coal bench samples from Illinois.--Continued

Sample Number	Ash	SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	CaO	MgO	Na <sub>2</sub> O	MnO	K <sub>2</sub> O	Fe <sub>2</sub> O <sub>3</sub>	TiO <sub>2</sub>	P <sub>2</sub> O <sub>5</sub>	SO <sub>3</sub>
SITE 14												
W192923	8.6	54	12.8	4.5	0.95	0.92	0.02	2.2	9.7	0.72	0.14	6.3
W192924	11	40.9	10.9	15.1	0.68	0.86	0.05	1.5	11.5	0.57	0.08	12.5
W192925	10.2	32.8	12.2	16	0.5	1.04	0.06	1	15	0.68	0.09	15.9
W192926	10.6	38.1	15.6	15.2	0.71	1.09	0.06	2	7.3	0.68	0.08	12.3
W192927	15.9	47.7	16.3	3.5	0.8	0.85	0.02	2.3	18.8	0.9	0.08	3.6
W192928	13.2	31.3	10	10.2	0.53	0.89	0.05	1.3	28	0.54	0.1	12.3
SITE 15												
W192929	12.8	14.1	4.5	2.9	0.35	0.49	0.02	0.97	67.6	0.36	0.06	4.2
W192930	10	18.4	7.4	14.9	0.33	0.73	0.05	0.54	36.4	0.45	0.07	15.1
W192931	11	16.7	7.3	24.3	0.35	1.05	0.08	0.55	17.6	0.42	0.05	27.2
W192932	14.8	27.8	11.4	17.7	0.53	0.95	0.06	1.3	14	0.64	0.07	21.9
W192933	16.5	48.3	7.3	8.3	0.75	0.99	0.03	2.3	10.4	0.91	0.08	8.7
W192934	13.3	31	12.3	6.3	0.4	0.8	0.02	1	36.8	0.7	0.06	5.8
SITE 16												
W192935	20.2	47.3	14	6.1	0.78	1.13	0.06	2.1	18.6	0.89	0.12	5.1
W192936	3.7	54.6	17.6	6.5	0.73	1.16	0.07	1.6	7.4	1	0.05	4
W192937	12.8	38.3	13.8	6.9	0.76	0.93	0.07	1.7	23.7	0.81	0.03	7.4
W192938	14.6	51.5	15.5	8.2	0.88	0.93	0.09	2.1	9.1	0.88	0.05	7.4
W192939	13.3	30	6.8	9.5	0.51	0.73	0.1	0.97	31.02	0.44	B	11.3
W192940	14.4	42.4	6.8	3.6	0.55	0.72	0.04	1.3	31	0.49	B	6

Table 2a.--Major- and minor- oxide composition of the laboratory ash of 41 coal associated rock samples from Illinois.  
[Values in percent. Coal ashed at 525°C. L means less than the value shown B, not determined. Sample number is USGS laboratory number.]

Sample Number	Ash	SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	CaO	MgO	Na <sub>2</sub> O	MnO	K <sub>2</sub> O	Fe <sub>2</sub> O <sub>3</sub>	TiO <sub>2</sub>	P <sub>2</sub> O <sub>5</sub>	SO <sub>3</sub>
SITE 1												
D176926	59.1	34	12	17	2.04	0.58	0.062	2.5	6.6	0.55	8.4	6.8
D176927	65.1	34	15	0.1 L	0.37	0.43	0.017	0.91	39	0.89	1 L	1.1
D176928	86	60	17	0.15	1.59	0.99	0.013	3	8.8	0.84	1 L	2.7
SITE 2												
D176929	91.3	56	16	4.3	1.77	0.98	0.049	3.4	6.6	0.79	1.1	3.9
D176930	56.8	23	11	0.1 L	0.43	0.36	0.011	0.75	43	0.47	1 L	1.6
D176931	91.9	64	21	0.14	1.43	0.89	0.019	3.1	3.1	0.98	1 L	1.3
SITE 3												
D176932	83.6	36	10	12	1.03	0.64	0.129	1.7	20	0.49	1 L	10
D176933	59.9	19	9.7	0.1 L	0.4	0.26	8	0.86	59	0.51	1 L	1.4
D176934	89.9	65	23	0.16	1.47	0.93	0.021	3.7	3.3	1.1	1 L	1.7
SITE 4												
D176935	96.5	89	9.1	0.1	0.49	1.47	0.019	1.5	1.4	0.63	1 L	1.1
D176936	81.8	59	27	0.1 L	1.55	0.65	0.018	5	3.3	1	1 L	0.92
D176937	92.8	62	23	0.64	1.67	0.81	0.013	4.5	3.3	1	1 L	0.63
SITE 5												
D176938	63.3	56	28	0.1 L	2.07	0.95	0.032	4.9	5.8	0.93	1 L	1.6
D176939	66	66	30	0.1 L	0.52	0.52	0.003	1.5	1.3	1.4	1 L	0.6
D176940	96.5	63	23	0.52	1.28	0.78	0.013	3.5	2.7	0.98	1 L	1
SITE 6												
W189324	66.7	47.2	15.3	0.3	1.1	1.76	0.142	3.1	18.3	0.7	0.1	6.9
W189325	87.2	39.1	14.3	0.7	0.98	0.57	0.025	2.6	23.4	0.7	0.4	12.2
SITE 7												
W189326	83.2	56.3	18.5	6.3	1.61	1.26	0.031	3.6	4.8	0.8	3.1	2.8
W189327	90	63.2	27	0.3	0.28	1.76	0.068	1.7	2.8	1.3	0.2	3
W189328	93.5	63.9	19.5	0.7	1.66	0.9	0.035	3.7	3.6	1	0.3	1.8
SITE 8												
W189329	92.7	55.8	17.8	0.3	0.35	2.03	0.063	4	6.9	0.8	0.09	5.3
W189330	90.9	59.1	24.9	0.2	0.45	1.08	0.052	1.5	5.5	1.3	0.05	4.6
W189331	92	60.9	19	0.7	1.51	0.96	0.031	3.6	3.9	1	0.2	2.6
SITE 9												
W189332	99.2	B	B	B	1.34	0.61	0.116	B	B	B	B	B
W189333	81.9	47.9	16.2	11	1.29	1.35	0.041	3.1	5.1	0.8	5.1	3.9
W189334	91.4	54.8	30	0.3	0.45	0.74	0.065	1.5	7.2	1	0.08	4
W189335	93	61.2	17.6	0.9	1.66	1.09	0.030	3.9	3.6	1	0.3	1.9
SITE 10												
W191101	90.2	44.9	14.6	13	2.66	0.89	0.065	2.8	6.1	0.7	0.5	4
W191102	87.7	61.1	21	0.5	2.49	0.86	0.017	4.6	4.6	1.1	0.1	1.7

Table 2a.--Major- and minor- oxide composition of the laboratory ash of 41 coal associated rock samples from Illinois.  
--Continued

Sample Number	Ash	SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	CaO	MgO	Na <sub>2</sub> O	MnO	K <sub>2</sub> O	Fe <sub>2</sub> O <sub>3</sub>	TiO <sub>2</sub>	P <sub>2</sub> O <sub>5</sub>	SO <sub>3</sub>
SITE 11												
W191103	96.3	51.8	21	0.2	2.16	1.09	0.026	3.9	6	1	0.05	1
W191104	90.9	60.1	28.2	0.2	1.26	0.62	0.004	3.7	2.7	1.4	B	1.3
SITE 13												
W191105	88.2	53.5	28.9	0.2	1.39	0.73	0.01	1.5	8.9	1.4	0.04	3
W191106	81.6	55.2	32.1	0.3	1.28	0.97	0.011	1.8	5.4	1.4	0.02	1.7
SITE 14												
W194841	65.1	58.2	17.2	2.6	1.66	1.17	0.017	3.9	4.7	0.81	1.2	2.8
W194842	91.3	63.6	20.3	0.95	1.44	1.01	0.025	3.9	3.2	1.2	0.47	0.92
SITE 15												
W194843	95.4	62.4	19.3	0.34	1.21	1.35	0.045	4	5.2	1	0.09	2
W194844	91.5	60.6	20	1.5	1.49	0.95	0.017	4.5	3.4	1.1	0.82	1.2
W194847	78	63.8	26.2	0.27	0.4	0.65	0.01	1.7	2.3	1.5	0.04	0.58
SITE 16												
W194845	57.5	54	16.4	3.9	1.99	1.03	0.026	3.9	5.9	0.8	2.2	4.6
W194846	90.5	61.1	18.5	0.92	1.83	0.92	0.019	4.2	4.3	0.97	0.3	2.4
W194848	46.1	26.8	9.1	32.9	0.58	0.28	0.323	0.78	2.3	0.4	0.07	5.4



Table 3.--Major-, minor-, and trace element composition of 92 coal bench samples from Illinois reported on a whole-coal basis. [Concentrations in parts-per-million. L means less than the value shown; B, not determined. For elements by emission spectrographic analysis, the standard deviation of any answer should be taken as plus 50% and minus 35%. See figures 1 and 2 for individual element analysis. Sample number is USGS laboratory number.]

Sample Number	Si	Al	Ca	Mg	Na	K	Fe	Ti	P	Ag
SITE 1										
D176941	4617	3000	4460	150	600	870	8364	684	1295.3	0.26
D176942	12862	5100	1140	270	860	850	8503	612	279.7 L	0.10
D176943	14953	7400	3280	280	1000	730	21678	1017	437.0 L	N
D176944	19626	10400	2200	460	1120	1400	33287	544	611.8 L	N
D176945	33813	14900	2770	730	1380	2340	9371	801	585.6 L	N
D176946	15140	8300	3170	380	1020	1100	35245	423	524.4 L	N
SITE 2										
D176947	32486	12500	7450	1240	1470	3290	13259	1039	690.5 L	N
D176948	10280	5100	6910	340	930	950	16000	284	384.6 L	N
D176949	14771	6900	7780	310	930	730	23629	332	476.3 L	N
D176950	38846	16400	4310	570	1450	2030	19378	1267	712.3 L	N
D176951	24182	11000	4110	550	1270	1720	9650	585	502.6 L	N
D176952	36897	15100	3600	770	1310	2380	21147	864	734.2 L	N
D176953	20280	9800	7640	470	1130	1250	30350	658	677.4 L	N
SITE 3										
D176954	16449	7400	6910	420	1150	1170	3077	737	384.6 L	N
D176955	16028	9300	4200	370	1420	1140	9594	938	428.3 L	N
D176956	25654	13600	4090	680	1720	2130	8531	715	533.1 L	N
D176957	17383	10800	1290	420	1120	1200	28531	517	524.4 L	N
SITE 4										
D176958	20065	12000	630	1040	1560	3290	14224	527	493.8 L	N
D176959	25864	15000	770	870	1180	3680	16343	596	537.5 L	N
D176960	43738	24200	4600	1250	1540	5880	20364	1194	909.0 L	N
D176961	22304	13500	370	670	1550	2310	12420	637	485.1 L	N
D176962	45533	23100	200	1230	1780	4050	5404	1105	734.2 L	N
D176963	12607	7500	4160	440	1250	1060	1638	318	310.3 L	N
D176964	17495	9100	5550	670	870	2000	3155	436	419.5 L	0.14
SITE 5										
D176965	B	B	B	210	940	B	4448	B	B	N
D176966	5944	4500	5300	1000	1120	660	1415	206	231.6 L	N
D176967	9458	7200	750	220	1110	840	1415	316	132.3 L	N
D176968	12785	9600	5100	410	1220	1010	957	445	332.1 L	N
D176969	29402	17300	860	790	1130	2320	1608	868	528.8 L	N
D176970	17065	10100	2960	490	1090	1170	3250	457	362.7 L	0.08
SITE 6										
W189298	26332	10300	1230	460	800	1820	12867	564	502.6 L	0.05 L
W189299	8995	4500	4560	140	310	270	15077	207	336.5 L	0.05
W189300	14093	9200	3400	480	340	1060	38937	530	506.9 L	0.07
W189301	21196	8000	3420	500	730	1470	23790	452	550.6 L	0.06
W189302	42393	13700	3930	1130	850	3100	7817	814	707.9 L	0.07 L
SITE 7										
W189303	12449	7200	1650	380	430	1440	14601	388	314.6 L	0.16
W189304	4981	2900	1900	240	280	50 L	107517	83 L	895.9 L	0.17
W189305	12491	5900	2550	430	440	780	4731	329	7.2	0.03
W189306	70028	33600	1290	1670	3550	3170	8348	1823	1110.0 L	0.16
W189307	19888	10100	3120	190	490	1210	16448	482	489.4 L	0.05 L
W189308	31206	13300	1890	790	630	2520	7666	693	550.6 L	0.06 L
W189309	15047	8100	7500	350	370	800	42098	360	611.8 L	0.06 L

Table 3.--Major-, minor-, and trace element composition of 92 coal bench samples from Illinois reported on a whole-coal basis.

Sample Number	Si	Al	Ca	Mg	Na	K	Fe	Ti	P	Ag
SITE 8										
W189310	11121	5200	1750	350	360	1110	12238	272	305.9 L	0.04
W189311	16037	7700	11140	360	460	950	5818	361	454.5 L	0.05 L
W189312	29551	13100	3900	630	990	2060	6677	675	541.9 L	0.06 L
W189313	16262	8600	3480	340	400	960	30825	465	506.9 L	0.07
SITE 9										
W189314	14178	6300	3330	500	450	1420	6727	350	323.4 L	0.05
W189315	14178	6700	3700	220	400	620	6210	310	323.4 L	0.05
W189316	21963	11100	2210	430	730	1410	6993	580	437.0 L	0.06
W189317	36701	17100	1760	580	780	3080	10338	893	673.0 L	0.07 L
W189318	35252	13900	1640	670	520	2730	20643	736	716.7 L	0.08 L
W189319	21439	10200	4540	310	510	1350	38294	469	646.8 L	0.08
SITE 10										
W191079	13935	7100	3500	520	700	1400	9839	377	24.5	0.44
W191080	17712	9000	6040	490	600	1450	12545	440	12.1	0.36
W191081	17865	9300	1910	370	600	1080	11725	484	14.2	0.06
W191082	6370	5000	720	120	410	160	14131	172	4.2	0.19
W191083	21398	13900	2570	530	820	1590	14455	761	46.3	0.06
W191084	43779	22800	2270	1750	970	4200	24846	1230	16.3	0.08
SITE 11										
W191085	6693	4200	3530	130	360	490	19523	237	86.5	0.28
W191086	6575	4100	3680	170	260	500	22115	240	58.6	0.06
W191087	6982	3000	3300	260	520	330	19866	160	14.6	0.04
W191089	5958	3900	250	130	350	460	18566	209	10.9	0.15
SITE 12										
W191088	30551	8600	8960	430	460	650	1630	531	48.5	0.02 L
W191090	19600	6700	11200	270	430	900	2330	410	8.6	0.02 L
W191091	30192	9200	15610	710	690	1890	9632	509	49.6	0.03 L
W191092	25174	8600	8030	530	850	1720	36741	531	12.9	0.03 L
W191093	34743	11600	19150	750	770	2230	11045	535	26.0	0.03 L
W191094	38009	10400	19560	740	690	2210	8126	596	217.6	0.03 L
SITE 13										
W191095	12530	7100	4980	580	430	1450	17989	456	47.6	0.46
W191096	14944	8000	2840	490	390	1100	15109	466	170.4	0.17
W191097	6212	5300	7420	210	460	210	7622	151	27.5	0.05
W191098	146313	88600	13490	5540	3520	9430	18503	5274	192.7	0.24
W191099	56209	32200	1440	1180	1410	3350	6579	1875	39.2	0.18
W191100	22387	12300	10290	1640	1420	2200	64449	607	88.7	0.20
SITE 14										
W192923	21701	5800	2760	490	580	1570	5834	370	52.6	0.36
W192924	21023	6300	11860	450	700	1370	8846	375	38.5	0.08
W192925	15634	6600	11650	300	780	850	10699	415	40.1	0.01
W192926	18872	8700	11500	450	850	1760	5411	431	37.1	0.01 L
W192927	35441	13700	3970	760	1000	3040	20903	856	55.6	0.05
W192928	19307	7000	9610	420	870	1430	25846	426	57.7	0.02

Table 3.--Major-, minor-, and trace element composition of 92 coal bench samples from Illinois reported on a whole-coal basis.--Continued

Sample Number	Si	Al	Ca	Mg	Na	K	Fe	Ti	P	Ag
SITE 15										
W192929	8434	3000	2650	260	460	1030	60509	276	33.6	0.09
W192930	8598	3900	10640	200	540	450	25455	269	30.6	0.02
W192931	8584	4200	19090	230	850	500	13538	276	24.0	0.01 L
W192932	19226	8900	18700	470	1030	1600	14490	566	45.3	0.01 L
W192933	37241	6400	9780	740	1200	3160	12000	898	57.7	0.05
W192934	19266	8700	5980	310	780	1110	34227	557	34.9	0.07
SITE 16										
W192935	44648	15000	8800	940	1690	3530	26274	1075	105.9	0.16
W192936	9440	3400	1720	160	310	490	1915	221	8.1	0.01
W192937	22908	9300	6310	580	880	1810	21214	620	16.8	0.02
W192938	35136	12000	8550	770	1000	2550	9291	768	31.9	0.01 L
W192939	18645	4800	9020	410	710	1070	28851	350	B	0.02
W192940	28531	5200	3700	470	760	1560	31217	422	B	0.04

Table 3.--Major-, minor-, and trace element composition of 92 coal bench samples from Illinois reported on a whole-coal basis.--Continued

Sample Number	As	B	Ba	Be	Br	Cd	Ce	Co	Cr	Cs	Cu
SITE 1											
D176941	4	156	1560	0.78	B	0.08	N	0.78	156	B	4.68
D176942	3	128	1280	0.96	B	2.05	N	0.96	12.8	B	3.46
D176943	4	150	2000	0.7	B	0.1 L	N	1.5	7	B	6.10
D176944	5	140	28	0.98	B	0.14 L	N	2.1	9.8	B	6.30
D176945	1	201	40	1.34	B	0.13	N	2.01	13.4	B	7.77
D176946	3	120	24	1.8	B	0.9	N	6	8.4	B	7.92
SITE 2											
D176947	8	237	1580	1.11	B	0.4	N	2.37	23.7	B	8.06
D176948	5	132	88	0.62	B	0.26	N	1.32	4.4	B	3.52
D176949	5	164	55	0.76	B	0.11 L	N	1.64	5.45	B	5.56
D176950	3	163	114	1.14	B	0.16	L	2.45	11.41	B	11.25
D176951	2	173	35	1.73	B	0.12	N	1.73	11.5	B	6.90
D176952	2	118	50	2.52	B	0.17 L	N	2.52	11.76	B	11.59
D176953	3	109	775	2.33	B	14.73	N	3.1	10.85	B	10.70
SITE 3											
D176954	1	132	1320	1.32	B	2.82	N	1.32	8.8	B	5.02
D176955	3	147	1960	1.47	B	0.2	N	1.47	6.86	B	5.98
D176956	2	183	61	1.83	B	0.12 L	N	1.83	8.54	B	7.69
D176957	4	180	36	1.8	B	2.28	N	3.6	8.4	B	11.40
SITE 4											
D176958	25	79	57	3.39	B	0.11	N	2.26	11.3	B	20.79
D176959	20	86	62	1.85	B	0.12 L	N	2.46	12.3	B	27.43
D176960	25	62	62	1.46	B	0.21 L	L	3.12	20.8	B	29.54
D176961	25	78	33	0.78	B	0.22	N	2.22	11.1	B	11.66
D176962	5	84	50	1.18	B	0.17	N	3.36	25.2	B	17.47
D176963	2	107	21	1.07	B	30.18	N	4.97	7.1	B	7.17
D176964	5	96	29	1.44	B	17.86	L	6.72	14.4	B	19.97
SITE 5											
D176965	1	56	8	1.4	B	0.21	N	4.2	2.8	B	3.22
D176966	1	80	16	1.59	B	0.45	N	3.71	3.71	B	2.86
D176967	1	66	13	1.32	B	0.04 L	L	3.08	6.6	B	5.90
D176968	1	53	23	0.53	B	1.03	N	2.28	11.4	B	6.54
D176969	1	61	36	0.85	B	0.12	N	3.63	12.1	B	10.77
D176970	4	83	25	0.83	B	0.66	L	8.3	8.3	B	9.05
SITE 6											
W189298	2.5	53 G	24	0.96	4	0.66	11	2.4	14.3	1.4	6.56
W189299	3.4	36 G	9	0.79	4	0.14	7	1.7	7.3	0.7 L	4.62
W189300	5.2	54 G	14	0.47	4	0.08	13	2	16.2	0.7	4.29
W189301	2.3	58 G	24	1.15	4	0.11	11	2.8	11.6	0.9	6.30
W189302	2.1	75 G	45	2.96	5	0.06	13	3.2	25.8	1.1	15.71
SITE 7											
W189303	2.6	33 G	24	0.89	2	1.22	8	1.4	39.7	0.8	6.70
W189304	11	22	17	0.92	3	0.16	54	1.7	8.4	1.2 L	4.10
W189305	0.4	26 G	21	0.66	2	0.03	5	1.3	8.3	0.8	4.73
W189306	1.2	106	68	1.16	3	0.06	30	1.8	35.3	0.8	11.18
W189307	2.5	52 G	20	0.65	2	0.02	9	3.1	13.8	0.9	9.18
W189308	1.1	58 G	43	1.5	2	0.06	11	3	18.2	1.8	16.38
W189309	6.1	65 G	15	1.97	2	0.07	13	7.3	13.8	0.4	10.08

Table 3.--Major-, minor-, and trace element composition of 92 coal bench samples from Illinois reported on a whole-coal basis.--Continued

Sample Number	As	B	Ba	Be	Br	Cd	Ce	Co	Cr	Cs	Cu
SITE 8											
W189310	4.2	32 G	19	0.97	4	0.05	10	1.9	11.4	0.8	6.09
W189311	1	48 G	25	0.86	2	0.04	9	1.6	11.4	0.8	5.93
W189312	0.9 L	58 G	47	1.69	2	2.11	11	2.6	24.6	1.5	8.68
W189313	3	54 G	15	1.47	2	0.03	8	4.6	18.1	1.1	8.93
SITE 9											
W189314	1.2	34 G	51	0.7	2	0.04	35	1.85	16.9	0.95	5.62
W189315	0.85	34 G	19	0.87	2	0.05	6	1.4	10.1	0.55	4.88
W189316	0.85	46 G	40	0.86	2	0.26	9	2.9	16.85	1.05	7.60
W189317	1.45	71 G	54	1.19	2	0.04	14	3	22.2	2	8.32
W189318	2.35	76 G	32	1.67	2	0.02	12.5	3.9	22.7	1.65	10.82
W189319	3.85	69 G	23	1.91	2	0.84	12	7.5	17.2	0.7	12.88
SITE 10											
W191079	1	133 G	32	2.66	5	1.47	4	1.1	7.2	0.8	7.00
W191080	1.2	175 G	35	5.34	5	0.11	4	1.5	9.3	0.9	8.00
W191081	2.3	154 G	31	3.48	5	0.05	4	1.8	9	0.7	19.44
W191082	2.8	91 G	6	2.78	5	0.08	2	11	11	0.2	10.08
W191083	4.7	191	50	5.72	5	0.07	7	9.2	22.1	1	14.84
W191084	7	176	77	4.86	5	0.09	12	6	24.7	1.6	20.57
SITE 11											
W191085	62.1	125 G	16	6.34	3	0.06	2	5.7	4.6	0.3	13.20
W191086	57.2	127 G	13	4.89	4	0.06	2	3.05	4.2	0.4	10.72
W191087	22.35	127 G	13	3.15	3.5	0.07	2	4.25	3.7	0.3	17.42
W191089	25.7	95 G	7	4.3	4	0.42	3	9.9	5	0.6	34.00
SITE 12											
W191088	0.3	111	47	6.11	6.5	54.39	4	0.9	8.75	0.25	5.33
W191090	0.2	137	24	4.8	7	92.12	4	0.9	8	0.4 L	5.88
W191091	9.8	185	61	3.41	6	5.54	4	1.7	7.5	0.6	4.83
W191092	7.4	281 G	46	3.26	6	0.11	5	1.6	8.7	0.7	5.18
W191093	3.3	194	73	3.58	6	2.83	6	1.9	9.6	0.7	5.96
W191094	1.6	183	65	2.99	5	0.07	8	1.7	10.2	0.8	7.47
SITE 13											
W191095	43.5	207 G	26	3.82	3	0.14	5	7.3	8.4	0.9	17.44
W191096	12.6	148 G	28	5.07	3	0.07	5	3.1	10	0.8	8.58
W191097	8.4	120 G	9	5.61	5	0.07	3	2.4	5.5	0.2	8.19
W191098	6.6	365	359	9.45	1	0.21	94	13.6	72	6.6	44.73
W191099	7.6	269	114	8.51	3	0.11	22	7.5	34.3	2.1	26.88
W191100	30.6	386 G	447	5.28	4	0.14	10	9.2	14	0.7	30.45
SITE 14											
W192923	1.8	86 G	32	1.38	19	22.36	10	1.4	185.4	0.8	7.48
W192924	2.2	110 G	41	0.89	19	0.34	7	1.3	9.9	1	5.50
W192925	2.1	102 G	60	0.54	19	0.17	7	1.8	8.2	0.5	5.81
W192926	0.7	106 G	25	0.4	19	1.8	10	1.7	11.7	0.8	6.89
W192927	4.8	159 G	86	1.02	17	2.7	19	4.4	19.1	1.8	12.24
W192928	4.4	132 G	28	1.98	20	0.44	12	5.2	11.6	0.6	11.09

Table 3.--Major-, minor-, and trace element composition of 92 coal bench samples from Illinois reported on a whole-coal basis.--Continued

Sample Number	As	B	Ba	Be	Br	Cd	Ca	Co	Cr	Cs	Cu
SITE 15											
W192929	13.5	128 G	15	3.33	16	0.37	4	1.8	20	0.5	5.50
W192930	7.3	100 G	10	0.9	20	0.7	5	1.7	5.8	0.3	6.00
W192931	2.5	110 G	12	0.42	22	0.25	5	1.7	5.8	0.3	4.95
W192932	4.7	148 G	22	0.5	20	0.33	11	1.9	10.2	0.9	6.81
W192933	2.8	165 G	33	1.06	20	0.54	16	3.9	16.6	1.6	10.89
W192934	10.7	133 G	12	1.08	21	0.08	9	10.7	16	0.6	9.44
SITE 16											
W192935	1.7	202 G	67	4.04	6	0.83	8	1.6	37	1.1	11.31
W192936	0.6	37 G	13	0.63	5	0.04	12	1.8	13.1	1.4	2.66
W192937	2.2	128 G	36	1.22	6	0.1	10	4.6	13.5	1.5	8.19
W192938	0.4	146 G	51	1.75	5	0.05	12	2.7	14.5	1.6	9.49
W192939	1.7	133 G	28	2.13	6	0.15	6	2.3	7.7	0.6	5.45
W192940	2.2	144 G	26	2.59	6	1.22	5	3.1	9.3	0.6	12.24

Table 3.--Major-, minor-, and trace element composition of 92 coal bench samples from Illinois reported on a whole-coal basis.--Continued

Sample Number	Dy	Er	Eu	F	Ga	Gd	Ge	Hf	Hg	La	Li
SITE 1											
D176941	B	B	N	415	1.56	B	36.4	N	0.06	N	0.94
D176942	B	B	N	45	1.28	B	12.8	N	0.07	N	1.79
D176943	B	B	N	35	3	B	N	N	0.11	N	5.10
D176944	B	B	N	60	2.8	B	N	N	0.14	N	6.72
D176945	B	B	N	85	4.02	B	N	N	0.06	13.4 L	7.77
D176946	B	B	N	45	2.4	B	18	N	0.13	N	3.12
SITE 2											
D176947	B	B	N	335	4.74	B	31.6	N	0.07	N	4.27
D176948	B	B	N	35	1.76	B	2.64	N	0.06	N	1.58
D176949	B	B	N	30	1.64	B	N	N	0.06	N	2.29
D176950	B	B	N	70	3.26	B	N	N	0.08	16.3 L	9.45
D176951	B	B	N	75	3.45	B	N	N	0.07	N	6.56
D176952	B	B	N	95	3.36	B	N	N	0.09	16.8 L	11.09
D176953	B	B	N	45	4.65	B	23.25	N	0.12	N	7.44
SITE 3											
D176954	B	B	N	20	2.64	B	13.2	N	0.04	8.8 L	2.64
D176955	B	B	N	35	1.96	B	N	N	0.07	N	6.96
D176956	B	B	N	60	2.44	B	N	N	0.06	12.2 L	8.17
D176957	N	N	N	45	3.6	N	18	N	0.09	N	8.16
SITE 4											
D176958	N	N	N	85	3.39	N	11.3	N	0.07	11.3 L	7.23
D176959	B	B	N	85	3.69	B	N	N	0.06	12.3 L	8.73
D176960	B	B	N	125	6.24	B	N	N	0.08	20.8 L	31.41
D176961	B	B	N	75	3.33	B	N	N	0.07	11.1 L	14.43
D176962	B	B	N	100	5.04	B	N	N	0.05	16.8 L	36.96
D176963	N	N	N	35	2.13	N	4.97	N	0.04	7.1 L	3.83
D176964	N	N	N	75	2.88	N	19.2	N	0.05	9.6 L	3.94
SITE 5											
D176965	N	N	N	20 B	1.96	N	28	N	0.04	N	1.51
D176966	N	N	N	35	1.59	N	10.6	N	0.04	N	1.80
D176967	B	B	N	50	1.32	B	4.4	N	0.04	4.4 L	6.56
D176968	B	B	N	35	2.28	B	N	N	0.04	7.6 L	8.36
D176969	B	B	N	60	3.63	B	N	N	0.04	12.1 L	30.13
D176970	N	N	N	45	2.49	N	5.81	N	0.04	8.3 L	11.12
SITE 6											
W189298	1.69 L	0.53 L	0.18	58	3.39	2.47 L	0.5	0.7	0.1	6	10.35
W189299	1.13 L	0.36 L	0.1	54	1.51	1.66 L	0.24 L	0.4 L	0.1	3	4.00
W189300	1.71 L	0.54 L	0.19	64	2.47	2.49 L	0.37 L	0.5 L	0.14	4	4.87
W189301	1.85 L	0.58 L	0.19	31	2.9	2.71 L	4.66	0.5	0.09	4	6.68
W189302	2.38 L	0.75 L	0.18	84	4.49	3.48 L	30.94	1.2	0.07	6	17.82
SITE 7											
W189303	1.06 L	0.33 L	0.11	74	1.97	1.55 L	3.87	0.3	0.07	3	3.46
W189304	3.01 L	0.95 L	0.79 L	52	4.39	3.01 L	0.65 L	0.6 L	0.11	1	2.46
W189305	0.81 L	0.34	0.25	52	1.97	0.81 L	0.17 L	0.3	0.05	2	4.51
W189306	3.73 L	1.18 L	0.35	84	4.88	5.46 L	0.8 L	1.4	0.08	15	68.58
W189307	1.65 L	0.52 L	0.24	64	2.74	1.65 L	0.35 L	0.4	0.06	4	4.93
W189308	1.85 L	0.65 L	0.25	84	4.4	2.71 L	0.4 L	0.6	0.07	5	11.34
W189309	2.06 L	0.65 L	0.25	74	4.03	3.01 L	10.63	0.4	0.13	3	6.16

Table 3.--Major-, minor-, and trace element composition of 92 coal bench samples from Illinois reported on a whole-coal basis.--Continued

Sample Number	Dy	Er	Eu	F	Ga	Gd	Ge	Hf	Hg	La	Li
SITE 8											
W189310	1.03 L	0.98	0.24	84	2.11	1.51 L	1.32	0.3	0.05	3	2.94
W189311	1.53 L	0.48 L	0.21	42	1.85	2.24 L	0.33 L	0.7	0.03	4	7.49
W189312	1.82 L	0.99	0.22	94	5.77	4.33	0.46	0.7	0.04	5	10.66
W189313	1.71 L	0.54 L	0.2	71	4.38	2.49 L	5.16	0.5	0.06	4	7.89
SITE 9											
W189314	1.09 L	0.48	0.1	74	2.97	1.59 L	6.57	0.6	0.04	2	3.70
W189315	1.09 L	0.58	0.15	54	2.31	2.34 L	0.23 L	0.45	0.03	2.5	5.48
W189316	1.47 L	0.71	0.17	84	3.05	2.15 L	0.32 L	0.6	0.04	4.5	11.00
W189317	2.26 L	0.71 L	0.5	142	4.84	3.31 L	0.49 L	0.9	0.04	7.5	13.71
W189318	2.41 L	1.01	0.48	130	5.1	3.53 L	0.52 L	0.8	0.04	6	12.14
W189319	2.18 L	0.69 L	0.17	54	4.56	3.18 L	11.81	0.65	0.05	5	7.70
SITE 10											
W191079	4.13 L	1.33 L	0.06	24	4.06	1.33	22.4	0.3	0.09	2	2.73
W191080	5.43 L	1.75 L	0.09	48	3.96	1.75	11.96	0.4	0.09	3	5.70
W191081	4.78 L	1.54 L	0.09	20	4.94	1.05 L	12.96	0.4	0.07	2	8.91
W191082	2.83 L	0.96	0.07	26	4.56	0.62 L	18.72	0.3	0.16	1	3.26
W191083	6.25 L	2.01 L	0.12	34	4.13	1.38 L	9.75	0.6	0.09	4	21.20
W191084	11.03 L	3.55 L	0.15	48	6.36	2.43 L	18.7	1	0.13	7	22.44
SITE 11											
W191085	4.49	1.25 L	0.25	140	5.61	5.02	53.46	0.2	0.18	1	1.85
W191086	3.95 L	1.27 L	0.21	20	3.35	3.95	27.47	0.2	0.09	1	1.61
W191087	3.95 L	1.27 L	0.22	48	3.55	3.08	16.08	0.1	0.11	1	1.21
W191089	2.95 L	1.35	0.18	20	4.95	0.65 L	46	0.2	0.11	1	8.00
SITE 12											
W191088	6.55 L	2.11 L	0.08	22	1.78	1.44 L	15.54	0.4	0.08	2	5.77
W191090	5.78 L	1.86 L	0.09	20	1.96	1.27 L	12.74	0.3	0.09	2	4.51
W191091	8.38 L	2.7 L	0.07	52	1.56	1.85 L	11.64	0.3	0.04	2	4.40
W191092	8.73 L	2.81 L	0.07	20	4	4.14	14.65	0.4	0.22	3	4.44
W191093	8.79 L	2.83 L	0.11	52	2.98	2.38	16.39	0.4	0.05	4	4.62
W191094	9.79 L	3.15 L	0.15	130	2.49	2.99	29.88	0.4	0.05	4	5.15
SITE 13											
W191095	6.43 L	2.07 L	0.11	20	6.76	1.42 L	26.16	0.3	0.25	2	3.71
W191096	4.6 L	1.48 L	0.13	120	5.46	1.01 L	18.72	0.4	0.17	3	14.82
W191097	3.72	1.2 L	0.12	22	5.8	2.27	22.05	0.2	0.13	1	3.21
W191098	37.17 L	11.97 L	1.06	170	14.49	8.19 L	5.54 L	3.8	0.15	52	296.10
W191099	13.22 L	4.26 L	0.36	92	6.27	2.91 L	6.94	1.4	0.2	11	69.44
W191100	11.98 L	3.86 L	0.2	72	8.32	6.29	46.69	0.6	0.39	5	19.69
SITE 14											
W192923	2.75 L	3.96 L	0.09	85	1.72	0.65	11.18	0.4	0.07	3	3.53
W192924	3.52 L	1.1 L	0.1	67	1.87	1.43	0.51 L	0.4	0.1	3	4.07
W192925	3.26 L	1.02 L	0.11	36	1.94	1.12	0.47 L	0.3	0.1	3	5.51
W192926	3.39 L	1.06 L	0.17	54	2.23	0.88	0.49 L	0.4	0.07	6	7.31
W192927	5.09 L	1.59 L	0.27	100	4.13	1.59	0.73 L	0.7	0.12	10	12.40
W192928	4.22 L	1.32 L	0.28	50	3.04	1.32 L	3.43	0.4	0.09	7	7.26



Table 3.--Major-, minor-, and trace element composition of 92 coal bench samples from Illinois reported on a whole-coal basis.--Continued

Sample Number	Dy	Er	Eu	F	Ga	Gd	Ge	Hf	Hg	La	Li
SITE 15											
W192929	4.1 L	1.28 L	0.15	27	7.81	1.28 L	25.88	0.6	0.2	2	2.94
W192930	3.2 L	1 L	0.11	23	2.3	1 L	0.46 L	0.3	0.1	2	3.90
W192931	3.52 L	1.1 L	0.1	24	1.87	1.54	0.51 L	0.2	0.07	2	3.19
W192932	4.74 L	1.48 L	0.17	68	2.81	2.07	0.68 L	0.4	0.06	6	9.32
W192933	5.28 L	1.65 L	0.25	86	5.28	1.39	0.76 L	0.7	0.05	8	16.17
W192934	4.26 L	1.33 L	0.17	43	5.05	0.9 L	0.8	0.4	0.04	5	11.97
SITE 16											
W192935	6.46 L	2.02 L	0.13	58	5.66	2.02 L	12.73	0.4	0.1	4	6.67
W192936	1.18 L	0.37 L	0.2	70	1.07	0.25 L	0.17 L	0.5	0.05	6	1.92
W192937	4.1 L	1.28 L	0.16	70	3.58	1.28 L	0.59 L	0.5	0.08	4	5.38
W192938	4.67 L	1.46 L	0.2	81	3.94	1.75	0.67 L	0.5	0.06	7	7.15
W192939	4.26 L	1.33 L	0.11	41	2.93	1.33 L	1.46	0.3	0.08	3	3.46
W192940	4.61 L	1.44 L	0.08	51	3.46	1.44 L	21.6	0.3	0.12	3	3.46

Table 3.--Major-, minor-, and trace element composition of 92 coal bench samples from Illinois reported on a whole-coal basis.--Continued

Sample Number	Lu	Mn	Mo	Nb	Nd	Ni	Pb	Pr	Rb	Sb	Sc
SITE 1											
D176941	B	21.32	36.4	1.56	B	15.6	1.56	B	B	3	1.56
D176942	B	19.84	9.6	1.28	B	4.48	1.6	L	B	B	0.96
D176943	B	45.5	3	2	B	5	2.5	L	B	B	1.50
D176944	B	43.4	2.1	2.8	B	7	3.5	L	B	B	2.10
D176945	B	42.88	2.01	2.68	N	9.38	3.35		B	B	4.02
D176946	B	52.8	1.2	2.4	B	36	5.4		B	B	1.80
SITE 2											
D176947	B	136.67	15.8	3.16	L	15.8	3.95		B	B	2.37
D176948	B	102.96	6.16	1.76	L	2.64	2.2	L	B	B	1.32
D176949	B	105.19	5.45	2.18	L	3.27	2.73	L	B	B	1.64
D176950	B	53.79	2.45	3.26	N	8.15	4.89		B	B	2.45
D176951	B	57.5	1.73	2.3	B	5.75	2.88		B	B	3.45
D176952	B	53.76	2.52	3.36	L	5.04	5.04		B	B	2.52
D176953	B	136.4	2.33	3.1	L	15.5	3.88		B	B	3.10
SITE 3											
D176954	B	139.92	4.4	1.76	L	6.16	2.2	L	B	B	1.32
D176955	B	63.21	1.96	1.96	B	4.9	2.45	L	B	B	1.96
D176956	B	67.71	1.83	2.44	L	6.1	3.05		B	B	2.44
D176957	N	28.2	1.8	2.4	L	12	7.2		B	B	2.40
SITE 4											
D176958	N	29.95	3.39	2.26	L	7.91	15.26		B	B	5.65
D176959	B	19.68	2.46	2.46	L	8.61	14.15		B	B	3.69
D176960	B	55.12	1.46	4.16	N	10.4	18.72		B	B	6.24
D176961	B	11.66	0.78	2.22	L	7.77	25.53		B	B	3.33
D176962	B	15.12	1.18	3.36	L	11.76	6.72		B	B	5.04
D176963	N	65.32	4.97	1.42	L	35.5	1.78		B	B	1.42
D176964	N	98.4	6.72	1.92	N	67.2	3.84		B	B	2.88
SITE 5											
D176965	N	28	0.56	0.56	L	28	5.6		B	B	1.96
D176966	N	147.87	0.8	1.06	L	15.9	9.01		B	B	1.59
D176967	B	8.8	0.66	0.88	L	6.6	29.92		B	B	1.32
D176968	B	79.04	0.76	1.52	L	5.32	18.62		B	B	2.28
D176969	B	24.2	1.82	2.42	L	12.1	18.15		B	B	3.63
D176970	N	49.39	4.15	1.66	L	41.5	19.09		B	B	2.49
SITE 6											
W189298	0.14	13.69	1.68	1.69	L	5.26	2.19		L	L	2.80
W189299	0.04	13.4	1.27	1.13	L	3.26	3.31		L	L	1.06
W189300	0.05	17.17	2.03	1.71	L	6.04	3.71		L	L	1.41
W189301	0.06	19.28	1.55	1.85	L	4.9	16.38		L	L	1.75
W189302	0.17	44.39	2.15	2.38	L	13.72	7.94		L	L	5.76
SITE 7											
W189303	0.17	9.5	42.91	1.06	L	12.31	1.8		L	L	1.52
W189304	0.05	8.38	17.84	3.01	L	1.03	4.1		L	L	0.38
W189305	0.04	10.4	4.85	0.81	L	4.03	1.93		L	L	0.49
W189306	1.3	19.05	1.69	3.73	L	7.72	14.48		L	L	4.74
W189307	0.07	17.02	1.94	1.65	L	4.39	2.02		L	L	2.12
W189308	0.09	19.53	1.9	1.85	L	7.96	3.4		L	L	3.01
W189309	0.11	49	4.62	2.06	L	29.26	21		L	L	2.68

Table 3.--Major-, minor-, and trace element composition of 92 coal bench samples from Illinois reported on a whole-coal basis.--Continued

Sample Number	Lu	Mn	Mo	Nb	Nd	Ni	Pb	Pr	Rb	Sb	Sc
SITE 8											
W189310	0.22	10.29	8.89	1.03 L	4.77 L	4.26	1.47	0.85	26 L	0.74	1.89
W189311	0.06	28.39	3.18	1.53 L	7.08 L	3.79	1.98	1.04 L	24 L	0.58	1.84
W189312	0.1	24.06	1.1	1.82 L	8.44 L	7.44	2.98	1.24 L	20	0.23	3.67
W189313	0.11	15.31	4.01	1.71 L	7.9 L	20.07	10.67	1.16 L	27 L	0.19	2.93
SITE 9											
W189314	0.39	18.13	27.23	1.09 L	5.04 L	14.65	2	0.74 L	18	0.31	1.45
W189315	0.07	12.43	5.8	1.09 L	5.04 L	5.04	1.63	0.87	20 L	0.32	1.61
W189316	0.07	15.6	3.32	1.47 L	6.81 L	8.43	2.1	1	21 L	0.24	2.44
W189317	0.1	24.02	1.94	2.26 L	10.49 L	7.05	3.39	1.54 L	31	0.21	3.36
W189318	0.12	16.89	2.79	2.41 L	11.17 L	7.4	9.68	1.64 L	29	0.8	3.71
W189319	0.15	19.24	11.44	2.34	10.08 L	34.19	28.12	1.48 L	15	0.29	3.03
SITE 10											
W191079	0.04	51.1	19.6	1.54	6.16 L	24.5	15.4	9.1 L	12	1.18	1.21
W191080	0.05	82.8	11.96	2.02	8.1 L	16.56	12.88	11.96 L	12	0.87	1.60
W191081	0.06	25.11	8.1	2.59	8.1	12.15	29.97	10.53	8	0.53	1.60
W191082	0.05	16.32	9.6	1.97	4.22 L	11.52	30.72	6.24 L	8 L	0.46	2.42
W191083	0.09	32.86	4.13	5.19	11.66	20.14	36.04	13.78 L	12	1.01	3.91
W191084	0.11	48.62	4.86	4.86	16.46 L	33.66	108.46	24.31 L	25	1.38	4.04
SITE 11											
W191085	0.08	29.7	2.77	2.71	7.92	33	244.2	8.58 L	8 L	5.3	1.78
W191086	0.09	31.49	3.55	1.61	5.9 L	18.09	194.3	8.71 L	4	3.13	0.95
W191087	0.1	35.51	2.55	1.07	5.9 L	15.41	134	8.71 L	5	2.26	0.84
W191089	0.1	10	4.45	1.3	4.4 L	39	145	6.5 L	6	3.33	3.09
SITE 12											
W191088	0.07	66.6	2.44	3	9.77 L	5.55	3.55	14.43 L	4	0.45	1.47
W191090	0.06	117.6	2.25	2.25	8.62 L	5	2.94	12.74 L	8 L	0.39	1.22
W191091	0.04	156.2	0.99	1.7	12.5 L	4.54	14.2	18.46 L	8	0.46	1.15
W191092	0.04	93.24	4.14	2.96	13.02 L	6.36	53.28	19.24 L	11	0.2	1.35
W191093	0.06	193.7	1.64	2.83	13.11 L	7.45	14.9	19.37 L	12	0.12	1.52
W191094	0.06	232.4	1.1	1.66	14.61 L	7.47	11.62	21.58 L	12	0.11	1.82
SITE 13											
W191095	0.09	51.23	23.98	2.18	9.59 L	28.34	228.9	14.17 L	18	5.43	1.41
W191096	0.1	28.86	14.04	2.96	6.86 L	15.6	85.8	10.14 L	10	2.79	1.72
W191097	0.08	60.48	6.93	0.57	5.54 L	10.08	4.28	8.19 L	7 L	1.92	1.99
W191098	0.37	57.96	11.34	21.42	88.2	69.3	63	81.9 L	57	1.2	10.01
W191099	0.18	60.48	11.87	10.08	11.36	35.84	91.84	29.12 L	24	1.51	5.57
W191100	0.1	62.93	13.2	3.25	17.86 L	46.69	345.1	26.39 L	14	3.11	2.92
SITE 14											
W192923	0.05 L	12.9	14.62	2.49	3.96 L	24.08	3.61	5.85 L	40 L	7.64	1.80
W192924	0.05	40.7	4.73	0.8	5.06 L	4.51	4.73	7.48 L	42 L	0.75	1.49
W192925	0.04	43.86	3.37	0.95	4.69 L	3.57	2.75	6.94 L	44 L	0.3	1.38
W192926	0.07	45.58	1.48	1.01	4.88 L	4.66	3.18	7.21 L	44 L	0.18	1.90
W192927	0.11	25.44	1.03	1.75	7.31 L	8.59	10.18	10.81 L	26	0.24	3.38
W192928	0.09	50.16	4.88	1.98	6.6	12.94	30.36	8.98 L	47 L	0.12	2.08

Table 3.—Major-, minor-, and trace element composition of 92 coal bench samples from Illinois reported on a whole-coal basis.—Continued

Sample Number	Lu	Mn	Mo	Nb	Nd	Ni	Pb	Pr	Rb	Sb	Sc
SITE 15											
W192929	0.11	21.76	2.82	5.76	5.89 L	10.24	1.28 L	8.7 L	37	L	4.64
W192930	0.03	39	1.1	1.4	4.6 L	3.8	3.2	6.8 L	36	L	1.01
W192931	0.03	67.1	0.98	1.21	5.06 L	3.3	2.31	7.48 L	39	L	1.02
W192932	0.06	65.12	1.41	2.81	6.81 L	5.33	4.44	10.06 L	43	L	1.83
W192933	0.1	34.65	0.91	1.65	7.59 L	7.92	6.27	11.22 L	46	L	3.33
W192934	0.07	22.61	4.52	1.86	6.12 L	22.61	21.28	9.04 L	37	L	3.20
SITE 16											
W192935	0.06	86.86	24.24	3.64	9.29 L	17.17	5.05	13.74 L	36	L	1.46
W192936	0.09	21.09	1.89	0.34	1.7 L	2.22	1.26	2.52 L	84	L	2.05
W192937	0.06	69.12	9.09	2.82	5.89 L	10.75	2.69	8.7 L	85	L	2.52
W192938	0.07	100.74	1.9	2.48	6.72 L	6.57	3.65	9.93 L	38	L	2.58
W192939	0.07	99.75	2.66	1.46	6.12 L	10.64	1.6	9.04 L	34	L	1.38
W192940	0.09	48.96	6.19	1.87	6.62 L	56.16	3.89	9.79 L	34	L	1.99

Table 3.--Major-, minor-, and trace element composition of 92 coal bench samples from Illinois reported on a whole-coal basis.--Continued

Sample Number	Se	Sm	Sn	Sr	Ta	Tb	Th	U	V	W	Y
SITE 1											
D176941	7.9	B	N	52	N	B	17.25	15.79	52	N	2.60
D176942	4.4	B	N	44.8	N	B	3.08	3.03	19.2	N	1.92
D176943	2.9	B	N	50	N	B	5.26	0.17	7	N	3.00
D176944	6.7	B	N	21	N	B		0.64	9.8	N	4.20
D176945	1.4	B	N	26.8	N	B	4.95	0.7	20.1	N	6.70
D176946	1.4	B	N	18	N	B		0.76	8.4	N	6.00
SITE 2											
D176947	2.1	B	N	47.4	N	B	10.07	9.11	23.7	N	4.74
D176948	1.2	B	N	26.4	N	B	4.23	0.48	6.16	N	2.64
D176949	1.4	B	N	32.7	N	B		0.42	7.63	N	3.27
D176950	3.4	B	N	24.45	N	B	2.89	0.83	16.3	N	4.89
D176951	1.4	B	N	34.5	N	B	3.87	0.53	17.25	N	5.75
D176952	1.1	B	N	25.2	N	B	3.26	1.08	16.8	N	5.04
D176953	1.8	B	N	31	N	B	6.45	0.75	15.5	N	7.75
SITE 3											
D176954	1.7	N	N	13.2	N	B	2.47	0.45	13.2	N	2.64
D176955	1.8	B	N	29.4	N	B	5.67	0.21	14.7	N	2.94
D176956	1.1	B	N	36.6	N	B		0.56	18.3	N	6.10
D176957	1.6	B	N	24	N	N		1.23	18	N	8.40
SITE 4											
D176958	2	N	N	33.9	N	N	5.19	0.9	33.9	N	7.91
D176959	1.7	N	N	36.9	N	B	5.5	1.59	36.9	N	6.15
D176960	2.7	N	N	62.4	N	B	6.06	1.3	31.2	N	10.40
D176961	2.5	N	N	33.3	N	B		0.84	16.65	N	5.55
D176962	1.9	N	N	25.2	N	B	6.87	1.14	25.2	N	8.40
D176963	1.7	N	N	21.3	N	B	4.36	0.33	10.65	N	4.97
D176964	2	N	N	28.8	N	N	3.19	1.68	48	N	6.72
SITE 5											
D176965	0.4	B	N	8.4	N	N	3.9	0.15	4.2	N	1.96
D176966	0.6	B	N	15.9	N	N		0.27	5.3	N	3.71
D176967	1.3	N	N	13.2	N	B		0.54	6.6	N	2.20
D176968	1	N	N	22.8	N	B	2.42	0.52	11.4	N	3.80
D176969	1.4	N	N	18.15	N	B	3.48	0.56	18.15	N	6.05
D176970	1.9	N	N	12.45	N	N	4.4	0.56	12.45	N	5.81
SITE 6											
W189298	1.9	0.9	1.69 L	20.24	0.14	0.23	1.7	1.19	10.01	B	3.63
W189299	1.6 L	0.6	1.13 L	12.4	0.04	0.56 L	0.6 L	0.23	4.54	B	4.32
W189300	2.1 L	0.7	1.71 L	10.2	0.17 L	0.63 L	0.7 L	0.36	7.08	B	3.45
W189301	2	0.7	1.85 L	14.36	0.1	0.67 L	0.8	0.59	10.33	B	4.46
W189302	1.6	0.9	2.38 L	23.65	0.19	0.21	2.6	2.09	43.09	B	6.50
SITE 7											
W189303	5.5	0.9	1.06 L	13.03	0.07	0.59 L	0.8	10.19	72	B	2.79
W189304	2.7 L	0.2	3.01 L	31.57	0.27 L	0.74 L	0.9 L	1	1.23	B	2.81
W189305	1.1	0.6	0.81 L	11.06	0.07	0.47 L	0.9	0.31	7.04	B	2.86
W189306	3.4	2	3.73 L	31.24	0.44	0.36	5.8	1.47	30.73	B	6.05
W189307	2	0.8	1.65 L	12.43	0.17 L	0.16	0.7 L	0.55	9.18	B	3.46
W189308	1.5	1.1	1.85 L	15.5	0.14	0.15	2.6	0.74	20.29	B	4.80
W189309	2.3 L	0.8	2.06 L	15.96	0.07	0.61 L	0.9 L	0.95	12.74	B	5.10

Table 3.--Major-, minor-, and trace element composition of 92 coal bench samples from Illinois reported on a whole-coal basis.--Continued

Sample Number	Se	Sm	Sn	Sr	Ta	Tb	Th	U	V	W	Y
SITE 8											
W189310	2.7	1.3	1.03 L	13.86	0.09	0.16	0.9	12.77	12.04	B	4.52
W189311	1.9	0.9	1.53 L	22.98	0.13	0.16	1.3	0.42	9.98	B	5.23
W189312	1.1	1.1	1.82 L	15.87	0.15	0.22	2.7	0.79	20.34	B	4.03
W189313	1.4	0.9	1.71 L	8.26	0.1	0.13	2.05	0.7	12.76	0.33	3.47
SITE 9											
W189314	1.9	0.9	1.09 L	12.36	0.1	0.08	1	16.47	16.87	0.39	1.64
W189315	2.2	0.55	1.09 L	10.8	0.08	0.14	1.1	0.47	8.51	0.36	3.37
W189316	1.85	0.95	1.47 L	15.9	0.15	0.12	1.1	1.17	15.8	0.36	3.44
W189317	1.6	1.1	2.26 L	17.09	0.2	0.7	2.8	1.16	19.1	0.43	3.14
W189318	1.3	1.25	2.41 L	17.71	0.16	0.17	2.8	0.92	21.32	0.45	5.72
W189319	1.6	0.9	2.18 L	11.47	0.12	0.19	1.9	1.28	17.91	0.34	5.70
SITE 10											
W191079	1.3	0.4	0.91 L	16.8	0.06	0.15 L	0.9	3.35	12.6	0.78 L	3.29
W191080	1.4	0.4	1.2 L	22.08	0.08	0.1	1.1	0.9	20.24	0.43	5.80
W191081	1.2	0.4	2.27 L	17.82	0.08	0.06	1.1	0.61	19.44	0.91 L	6.64
W191082	2	0.3	1.15	9.12	0.02	0.09	0.9	1	24	1.13 L	5.28
W191083	2.6	0.6	1.38 L	24.38	0.13	0.12	2.4	0.81	43.46	1.43 L	7.84
W191084	1.9	0.9	2.43 L	28.05	0.3	0.15	3.1	1.15	41.14	1.52 L	9.35
SITE 11											
W191085	1.3	1.1	0.86 L	15.84	0.04	0.25	0.7	1	9.9	1.23 L	17.16
W191086	1.05	0.85	0.87 L	14.74	0.05	0.21	0.6	1	8.04	0.31	13.40
W191087	1.05	0.75	0.87 L	17.42	0.02	0.24	0.45	1	4.89	1.33 L	12.73
W191089	1.1	0.8	0.65 L	9	0.03	0.24	0.7	1	20.5	0.17	9.50
SITE 12											
W191088	1.8	0.4	1.44 L	28.86	0.1	0.07	1.3	0.71	19.98	1.45 L	5.99
W191090	1.9	0.4	1.27 L	25.48	0.08	0.08	1	1	15.68	0.73 L	5.29
W191091	2.3	0.3	1.85 L	38.34	0.07	0.08	1	1	17.04	0.66 L	5.54
W191092	1.1	0.4	1.92 L	17.76	0.09	0.21 L	1.2	1	17.76	0.73 L	4.44
W191093	1	0.5	1.94 L	47.68	0.09	0.2 L	1.4	1	20.86	0.69 L	7.45
W191094	0.6	0.8	2.16 L	58.1	0.11	0.1	1.5	1	19.92	0.74 L	7.64
SITE 13											
W191095	1.4	0.5	1.42	19.62	0.08	0.12	1.1	0.97	15.26	0.2	8.94
W191096	1.7	0.6	1.01 L	24.96	0.09	0.13	1.3	1	21.06	0.4	11.70
W191097	1.4	0.5	0.82 L	24.57	0.02	0.13	0.6	1	14.49	0.29	12.60
W191098	3.6	5.2	8.19 L	126	0.9	0.52	11.4	2.91	119.7	1.93	28.98
W191099	3	1.6	2.91 L	49.28	0.4	0.19	5	1.4	60.48	0.7	16.13
W191100	2.6	0.9	2.64 L	32.48	0.1	0.2	1.8	1.38	26.39	1.38 L	10.35
SITE 14											
W192923	13.4	1.1	0.6	31.82	0.08	0.66 L	0.9	19.76	86	G	2.92
W192924	5.5	0.6	0.75 L	34.1	0.08	0.07	1	3.87	13.2	0.72	2.53
W192925	2.7	0.6	0.69 L	35.7	0.08	0.09	1.1	0.63	9.89	0.47	2.96
W192926	1	0.8	0.72 L	30.74	0.09	0.12	1.1	0.59	10.6	0.21	3.50
W192927	2	1.3	1.08 L	28.62	0.16	0.17	2.7	0.79	19.08	0.29	4.45
W192928	1.3	1	0.9 L	34.32	0.09	0.12	1.5	0.58	17.16	0.57 L	6.20

Table 3.--Major-, minor-, and trace element composition of 92 coal bench samples from Illinois reported on a whole-coal basis.--Continued

Sample Number	Se	Sm	Sn	Sr	Ta	Tb	Th	U	V	W	Y
SITE 15											
W192929	2.1	0.7	0.87 L	33.28	0.05	0.11	0.5	3.27	39.68	0.64	5.25
W192930	2.4	0.4	0.68 L	41	0.05	0.77 L	0.7	0.24	7.3	0.49 L	3.30
W192931	1.2	0.5	0.75 L	46.2	0.06	0.09	0.8	0.28	8.14	0.52 L	3.74
W192932	1.6	0.9	1.01 L	45.88	0.11	0.14	1.6	0.58	20.72	0.6 L	5.03
W192933	2.3	1.2	1.12 L	33	0.17	0.19	2.5	0.78	19.8	0.35	5.28
W192934	3	0.9	0.9 L	23.94	0.13	0.87 L	2.2	0.66	19.95	0.29	3.99
SITE 16											
W192935	4.2	0.7	1.37 L	54.54	0.09	0.8 L	1.1	2.2	66.66	0.36	6.06
W192936	3.1	1.1	0.25 L	10.73	0.14	0.14	1.5	0.5	4.07	1.33 L	1.11
W192937	3.3	0.8	0.87 L	32	0.1	0.11	1.9	0.75	17.92	1.3 L	4.74
W192938	1.4	1	0.99 L	40.88	0.14	0.11	2.1	0.55	18.98	0.58 L	5.40
W192939	1	0.6	0.9 L	31.92	0.07	0.11	1.1	0.3	7.98	0.32	4.12
W192940	1	0.4	0.98 L	21.6	0.09	0.73 L	1	0.87	10.08	0.31	5.04

Table 3.--Major-, minor-, and trace element composition of 92 coal bench samples from Illinois reported on a whole-coal basis.--Continued

Sample Number	Yb	Zn	Zr
SITE 1			
D176941	B	12.8	15.6
D176942	B	159.4	9.6
D176943	B	10.5	10.0
D176944	B	8.1	14.0
D176945	0.67	13.7	20.1
D176946	B	106.2	8.4
SITE 2			
D176947	0.47	45.3	23.7
D176948	B	72.2	4.4
D176949	B	12.2	5.5
D176950	0.82	30.8	32.6
D176951	0.58	26.8	17.3
D176952	B	16.3	25.2
D176953	B	2599.4	23.3
SITE 3			
D176954	0.26	359.0	13.2
D176955	0.29	25.6	14.7
D176956	0.61	40.7	18.3
D176957	B	276.0	24.0
SITE 4			
D176958	B	26.1	17.0
D176959	B	15.6	18.5
D176960	1.04	15.2	31.2
D176961	0.56	48.3	16.7
D176962	0.84	39.5	25.2
D176963	0.5	2208.1	10.7
D176964	0.67	1886.4	28.8
SITE 5			
D176965	0.2	38.1	4.2
D176966	0.37	126.7	5.3
D176967	0.31	12.1	6.6
D176968	0.53	186.2	11.4
D176969	0.85	52.0	18.2
D176970	0.58	173.5	12.5
SITE 6			
W189298	0.9	89.7	7.8
W189299	0.5 L	27.7	9.3
W189300	0.6 L	8.4	10.0
W189301	0.7 L	9.1	14.2
W189302	1.1	11.8	48.4
SITE 7			
W189303	0.3	7.9	19.5
W189304	0.8 L	69.7	1.0 L
W189305	0.4	12.1	8.5
W189306	0.8	14.5	40.9
W189307	0.6 L	5.0	20.5
W189308	0.5	12.6	19.9
W189309	0.7 L	10.5	36.0



Table 3.--Major-, minor-, and trace element composition of 92 coal bench samples from Illinois reported on a whole-coal basis.--Continued

Sample Number	Yb	Zn	Zr	
SITE 8				
W189310	0.6	11.9	15.1	
W189311	0.3	10.4	15.1	
W189312	0.7	533.2	11.3	
W189313	0.55	8.5	7.2	
SITE 9				
W189314	0.25	8.1	6.2	
W189315	0.3	14.1	12.0	
W189316	0.4	60.0	11.3	
W189317	0.6	12.9	11.1	
W189318	0.6	11.5	33.9	
W189319	0.8	192.4	63.2	
SITE 10				
W191079	0.2	315.0	13.3	
W191080	0.3	15.6	31.3	
W191081	0.3	9.7	34.0	
W191082	0.3	5.8	26.4	
W191083	0.5	8.3	62.5	
W191084	0.7	14.0	78.5	
SITE 11				
W191085	0.5	3.6	25.7	
W191086	0.55	2.9	18.1	
W191087	0.6	5.0	9.4	
W191089	0.6	21.5	24.5	
SITE 12				
W191088	0.3	3885.0	51.1	
W191090	0.3	7350.0	29.4	
W191091	0.2	340.8	36.9	
W191092	0.2	5.8	40.0	
W191093	0.3	178.8	47.7	
W191094	0.4	11.0	31.5	
SITE 13				
W191095	0.5	9.9	30.5	
W191096	0.6	7.2	38.2	
W191097	0.5	8.2	15.1	
W191098	2.2	11.3	239.4	
W191099	1	12.8	114.2	
W191100	0.6	44.7	40.6	
SITE 14				
W192923	0.4	1376.0	31.0	
W192924	0.3	41.8	10.5	
W192925	0.3	31.6	13.3	
W192926	0.4	169.6	14.8	
W192927	0.6	238.5	14.2	
W192928	0.5	38.3	29.0	

Table 3.--Major-, minor-, and trace element composition of 92 coal bench samples from Illinois reported on a whole-coal basis.--Continued

Sample Number	Yb	Zn	Zr
SITE 15			
W192929	0.7	17.9	53.8
W192930	0.2	130.0	13.0
W192931	0.2	35.2	16.5
W192932	0.4	45.9	26.6
W192933	0.6	42.9	19.8
W192934	0.5	13.3	13.3
SITE 16			
W192935	0.3	54.5	40.4
W192936	0.4	3.7	5.9
W192937	0.5	7.2	29.4
W192938	0.4	10.2	30.7
W192939	0.4	13.2	13.0
W192940	0.5	66.2	27.4

Table 3a.--Major-, minor-, and trace element composition of 41 coal associated samples from Illinois reported on a whole-rock basis.  
[Concentrations in parts-per-million. L means less than the value shown; N, detected; G greater than value shown; B, not determined. Sample number is USGS laboratory number.]

Sample Number	Si	Al	Ca	Mg	Na	K	Fe	Ti	P	Ag
SITE 1										
D176926	93897	3800	71700	7300	2500	12300	27277	1900	21694	4.14
D176927	103430	5200	400 L	1500	2100	4900	177545	3500	2845 L	N
D176928	241121	7700	900	8200	6300	21500	52923	4300	3758 L	N
SITE 2										
D176929	238916	7700	28000	9700	6600	25800	42138	4300	4389	N
D176930	61047	3300	400 L	1500	1500	3500	170797	1600	2482 L	N
D176931	274841	10200	900	7900	6100	23700	19922	5400	4016 L	N
SITE 3										
D176932	140636	4400	71600	5200	4000	11800	115923	2400	3653 L	N
D176933	53182	3100	400 L	1400	1200	4300	247140	1800	2618 L	N
D176934	273061	10900	1000	8000	6200	27700	20746	5900	3929 L	N
SITE 4										
D176935	401332	4600	600	2800	10500	12000	9448	3600	4217 L	N
D176936	225323	11700	500 L	7600	3900	34000	18877	4900	3575 L	N
D176937	268860	11300	4200	9300	5600	34700	21415	5500	4055 L	N
SITE 5										
D176938	165645	9400	400 L	7900	4500	25800	25674	3500	2766 L	0.63
D176939	203551	10500	400 L	2100	2500	8200	6000	5500	2884 L	N
D176940	284089	11700	3500	7400	5600	28100	18220	5700	4217 L	N
SITE 6										
W189324	147114	5400	1400	4400	8600	17200	85357	2800	291	0.33
W189325	159323	6600	4300	5100	3600	18900	142691	3700	1524	0.35
SITE 7										
W189326	218886	8100	37400	8100	7700	24900	27927	4000	11271	2.41
W189327	265794	12900	1900	1500	11700	12700	17622	7000	787	0.17
W189328	279189	9600	4600	9400	6200	28800	23538	5600	1226	0.15
SITE 8										
W189329	241713	8700	1900	1900	13900	30900	44729	4400	365	0.19
W189330	251037	12000	1300	2500	7200	11300	34962	7100	199	0.22
W189331	261813	9200	4600	8400	6500	27600	25091	5500	804	0.17
SITE 9										
W189332	B	B	B	8000	4400	B	B	B	B	0.1 L
W189333	183318	7000	64300	6400	8100	21100	29209	3900	18253	2.05
W189334	234052	14500	2000	2500	5000	11400	46020	5500	320	0.16
W189335	265963	8700	6000	9300	7500	30200	23413	5600	1219	0.23
SITE 10										
W191101	189251	7000	83700	14400	5900	21000	38477	3800	1971	0.09 L
W191102	250396	9700	3100	13200	5600	33600	28211	5800	383	0.1

Table 3a.--Major-, minor-, and trace element composition of 41 coal associated samples from Illinois reported on a whole-rock basis.--Continued

Sample Number	Si	Al	Ca	Mg	Na	K	Fe	Ti	P	Ag
SITE 11										
W191103	233100	10700	1300	12500	7800	31200	40406	5800	210	0.1 L
W191104	255285	13600	1300	6900	4100	28000	17163	7600	B	0.18
SITE 13										
W191105	220500	13500	1200	7400	4700	11000	54894	7400	154	0.26
W191106	210482	13900	1700	6300	5800	12200	30814	6800	71	0.31
SITE 14										
W194841	177048	5900	12000	6500	5600	21100	21397	3200	3414	7.16
W194842	271340	9800	6100	7900	6800	29600	20431	6600	1875	0.11
SITE 15										
W194843	278176	9700	2300	7000	9500	31700	34691	5700	375	0.1 L
W194844	259107	9700	9800	8200	6400	34300	21755	6000	3279	0.09 L
W194847	232542	10800	1500	1900	3700	11000	12545	7000	136	0.24
SITE 16										
W194845	145093	5000	16000	6900	4300	18700	23724	2800	5528	4.08
W194846	258390	8900	5900	10000	6100	31600	27213	5200	1186	0.17
W194848	57733	2200	108300	1600	970	3000	7415	1100	141	0.05 L

Table 3a.—Major-, minor-, and trace element composition of 41 coal associated samples from Illinois reported on a whole-rock basis.—Continued

Sample Number	As	Au	B	Ba	Be	Bi	Br	Cd	Ce	Co	Cr
SITE 1											
D176926	35.0	N	89	414	N	N	N	B	117.02	296 L	8.87
D176927	15.0	N	65	130	N	N	N	B	0.65 L	325 L	59.1
D176928	5.0	N	129	258	N	N	N	B	0.86 L	N	45.6
SITE 2											
D176929	25.0	N	137	457	N	N	N	B	0.91 L	457 L	17.2
D176930	10.0	N	85	170	N	N	N	B	0.57 L	N	274.
D176931	2.0	N	138	276	N	N	N	B	0.92 L	N	28.4
SITE 3											
D176932	250.0	N	42	836	N	N	N	B	0.84 L	N	138.
D176933	15.0	N	30	90	N	N	N	B	0.6 L	N	125.
D176934	4.0	N	135	450	4.5	N	N	B	0.9 L	450 L	17.9
SITE 4											
D176935	8.0	N	48	290	N	N	N	B	0.97 L	N	135.
D176936	8.0	N	123	573	5.7	N	N	B	0.82 L	409 L	9.65 L
D176937	4.0	N	139	464	6.5	N	N	B	0.93 L	N	12.3
SITE 5											
D176938	25.0	N	95	443	3.2	N	N	B	0.63 L	317 L	9.28 L
D176939	8.0	N	99	198	N	N	N	B	0.66 L	N	28.95
D176940	20.0	N	145	290	N	N	N	B	0.97 L	N	12.3
SITE 6											
W189324	19.2	6.7 L	160	220	2.1	14.7 L	9.0	0.6	72	12.4	76.7
W189325	30.3	8.7 L	148	157	3.6	19.2 L	1.0	0.35	96	24.6	64.1
SITE 7											
W189326	14.0	8.3 L	175	433	2.5	18.3 L	2.0	14.1	96	15.9	391.
W189327	4.8	9 L	297	459	3.5	19.8 L	2.0 L	0.1	211	17.4	64.6
W189328	3.4	9.4 L	215	299	3.6	20.6 L	2.0	0.37	85	11.8	107.
SITE 8											
W189329	14.1	9.3 L	167	519	2.7	20.4 L	2.0 L	0.32	76	16.9	102.
W189330	5.4	9.1 L	255	336	3.3	20.0 L	2.0	0.13	112	13.3	63.5
W189331	2.7	9.2 L	193	258	3.1	20.2 L	2.0 L	0.09 L	129	13.1	95.9
SITE 9											
W189332	4.0	9.9 L	5	15 L	0.7 L	21.8 L	1.5	0.1 L	22	4.95	27.3
W189333	2.3 L	8.2 L	164	295	1.6	18.0 L	2.0 L	13.1	139	16.8	199.
W189334	11.2	9.1 L	229	320	2.6	20.1 L	2.0 L	0.16	186	18.6	57.3
W189335	10.2	9.3 L	242	270	3.6	20.5 L	2.0 L	0.09 L	118	18.6	97.2
SITE 10											
W191101	21.7	9 L	108	289	3.1	19.8 L	1.67	0.2	59	18.87	82.6
W191102	7.9	8.8 L	167	351	4.5	19.3 L	1.0	0.53	58	15.1	89.2
SITE 11											
W191103	4.2	9.6 L	116	356	3.5	21.2 L	1.0	0.1 L	82	13.5	85.1
W191104	4.0	9.1 L	136	291	4.3	20.0 L	1.0	1.18	121	9.8	107.

Table 3a.—Major-, minor-, and trace element composition of 41 coal associated samples from Illinois reported on a whole-rock basis.—Continued

Sample Number	As	Au	B	Ba	Be	Bi	Br	Cd	Ce	Co	Cr
SITE 13											
W191105	27.3	8.8 L	176	185	3.4	19.4 L	2.0	0.34	138	19.8	93.5
W191106	11.6	8.2 L	220	269	3.7	17.95 L	2.0	0.15	77	13.67	66.27
SITE 14											
W194841	22.8	6.5 L	104	234	2.6	14.32 L	8.9	84.63	83	12.55	812.65
W194842	3.8	9.1 L	183	192	3.6	20.09 L	2.59	0.22	88	11.3	103.7
SITE 15											
W194843	10.8	9.5 L	105	324	3.1	20.99 L	1.72	0.1 L	86	19.4	82.7
W194844	5.1	9.2 L	174	220	3.5	20.13 L	2.37	0.2	89	12.2	107.0
W194847	6.8	7.8 L	164	203	2.2	17.16 L	4.1	0.08 L	125	12.65	64.1
SITE 16											
W194845	12.0	5.8 L	115	265	2.5	12.65 L	8.73	18.98	67	10.9	773.2
W194846	3.6	9.1 L	154	561	3.2	19.91 L	1.31	2.35	66	15.7	141.25
W194848	0.6	4.6 L	65	92	0.9	10.14 L	5.67	0.25	52	2.5	27.6

Table 3a.—Major-, minor-, and trace element composition of 41 coal associated samples from Illinois reported on a whole-rock basis.—Continued

Sample Number	Cs	Cu	Dy	Er	Eu	F	Ga	Gd	Ge	Hf	Hg
SITE 1											
D176926	B	176.0	N	N	N	7845	17.7	N	N	N	0.239
D176927	B	30.6	B	B	N	80	B	B	N	N	0.422
D176928	B	50.7	B	B	N	1015	25.8	B	N	N	0.164
SITE 2											
D176929	B	59.3	N	N	N	3715	27.4	N	N	N	0.054
D176930	B	28.9	B	B	N	75	B	B	N	N	0.252
D176931	B	45.9	B	B	N	905	27.6	B	N	N	0.024
SITE 3											
D176932	B	42.6	B	B	N	940	12.5	B	N	N	0.087
D176933	B	24.6	B	B	N	20	B	B	N	N	0.349
D176934	B	51.2	B	B	N	810	27.0	B	N	N	0.01 L
SITE 4											
D176935	B	25.1	B	B	N	210	9.7	B	N	N	0.01 L
D176936	B	43.4	B	B	N	680	24.5	B	N	N	0.027 L
D176937	B	46.4	B	B	N	1055	27.8	B	N	N	0.01 L
SITE 5											
D176938	B	96.8	B	B	N	455	19.0	B	N	N	0.062
D176939	B	52.8	B	B	N	290	13.2	B	N	N	0.028
D176940	B	69.5	B	B	N	880	29.0	B	N	N	0.079
SITE 6											
W189324	5.05	107.	21.3 L	6.67 L	1.29	1000	22.7	4.5 L	3.1 L	2.3	0.15
W189325	5.7	72.	27.9 L	8.72 L	1.09	860	27.0	5.9 L	4.0 L	3.4	0.42
SITE 7											
W189326	6.1	91.5	26.6 L	8.32 L	1.58	3100	25.0	6.9	3.8 L	3.6	0.12
W189327	8.0	54.0	28.8 L	9.0 L	0.97	2300	23.4	6.1 L	4.1 L	4.1	0.09
W189328	10.3	37.4	29.9 L	9.35 L	1.18	1000	34.6	6.4 L	4.3 L	5.1	0.027
SITE 8											
W189329	7.35	83.4	29.7 L	9.27 L	0.85	940	37.1	6.3 L	4.3 L	3.8	0.09
W189330	8.7	47.3	29.1 L	9.09 L	0.96	620	20.0	6.2 L	4.2 L	3.7	0.12
W189331	9.4	38.6	29.4 L	9.2 L	1.41	2300	27.6	6.3 L	4.2 L	4.8	0.03
SITE 9											
W189332	0.9	23.8	31.7 L	9.92 L	0.39	3200 B	2.2 L	6.7 L	4.6 L	0.7	0.043
W189333	5.1	76.9	26.2 L	8.19 L	2.17	3200	26.2	9.0	3.8 L	4.2	0.09
W189334	7.7	76.7	29.3 L	9.14 L	1.28	740	16.5	6.2 L	4.2 L	3.9	0.11
W189335	9.4	41.8	29.8 L	9.3 L	1.47	2500	35.3	6.3 L	4.3 L	5.6	0.043
SITE 10											
W191101	5.93	31.6	28.9 L	9.02 L	1.48	930	16.2	10.8	4.1 L	3.3	0.110
W191102	8.7	31.6	28.1 L	8.77 L	1.22	940	32.4	6.0 L	4.0 L	4.8	0.130
SITE 11											
W191103	8.2	27.9	30.8 L	9.63 L	1.66	1300	32.7	6.5 L	4.4 L	4.8	0.072
W191104	10.9	42.7	29.1 L	9.09 L	1.72	780	34.5	6.2 L	4.2 L	6.2	0.023

Table 3a. --Major-, minor-, and trace element composition of 41 coal associated samples from Illinois reported on a whole-rock basis. --Continued

Sample Number	Cs	Cu	Dy	Er	Eu	F	Ga	Gd	Ge	Hf	Hg
					SITE 13						
W191105	9.2	69.7	28.2 L	8.82 L	2.0	290	15.9	6.0 L	4.1 L	5.3	0.29
W191106	9.93	57.1	26.1 L	8.16 L	1.02	220	13.9	5.5 L	3.8 L	4.2	0.20
					SITE 14						
W194841	6.25	143.2	20.8 L	6.51 L	1.44	780	15.6	4.4 L	3.0 L	2.8	0.66
W194842	12.7	47.5	29.2 L	9.13 L	1.47	790	31.0	6.2 L	4.2 L	5.4	0.45
					SITE 15						
W194843	7.2	34.3	30.5 L	9.54 L	1.43	380	30.5	6.5 L	4.4 L	4.6	0.48
W194844	11.9	47.6	29.3 L	9.15 L	1.69	1100	25.6	6.2 L	4.2 L	4.9	0.30
W194847	7.4	39.8	24.9 L	7.8 L	1.13	280	21.1	5.3 L	3.6 L	3.6	0.30
					SITE 16						
W194845	4.4	161.	18.4 L	5.75 L	1.19	780	15.5	3.9 L	2.6 L	2.2	0.5
W194846	10.9	17.2	28.9 L	9.05 L	1.04	740	29.9	6.2 L	4.2 L	4.2	0.48
W194848	2.0	12.5	14.7 L	4.61 L	0.92	120	3.6	5.1	2.1 L	0.7	0.30



Table 3a.--Major-, minor-, and trace element composition of 41 coal associated samples from Illinois reported on a whole-rock basis.--Continued

Sample Number	La	Li	Lu	Mn	Mo	Nb	Nd	Ni	Pb	Pr	Rb
SITE 1											
D176926	88.7	17.1	N	284	118.2	11.8 L	N	295.0	26.6	B	B
D176927	65.1 L	44.9	B	85	N	13.	N	65.1	19.5	N	B
D176928	86.0 L	19.8	B	86	N	17.2	N	60.2	47.3	N	B
SITE 2											
D176929	91.3 L	21.0	N	347	27.4	18.3 L	N	91.3	36.5	N	B
D176930	56.8 L	30.7	B	48	8.5	11.4 L	N	17.0	14.2	N	B
D176931	91.9 L	25.7	B	138	N	18.4 L	N	27.6	22.9 L	N	B
SITE 3											
D176932	N	10.0	B	836	25.1	16.7 L	B	58.5	20.9 L	B	B
D176933	N	23.4	B	39	9.0	11.9 L	B	8.99	14.9 L	B	B
D176934	89.9 L	31.5	B	148	N	17.9	134.85 L	44.9	22.4 L	N	B
SITE 4											
D176935	N	12.5	B	145	N	19.3 L	B	14.5	24.1 L	B	B
D176936	81.8 L	95.7	B	115	N	16.4	N	24.5	20.4 L	N	B
D176937	92.8 L	21.3	B	93	N	18.6	139.2 L	46.4	23.2 L	N	B
SITE 5											
D176938	63.3 L	65.2	B	158	N	12.7 L	94.95 L	94.9	88.6	N	B
D176939	66.0	226.	B	17	9.9	13.2	N	33.0	91.1	N	B
D176940	96.5 L	33.8	B	97	9.7	19.3	N	67.6	24.1 L	N	B
SITE 6											
W189324	39.0	29.3	0.39	734	8.7	8.67	30.68 L	38.0	15.3	45 L	114
W189325	68.0	54.9	0.35	166	5.5	13.1	40.11 L	95.9	436.0	68	117
SITE 7											
W189326	53.0	36.6	0.59	200	39.1	9.98	38.27 L	158.1	15.8	57 L	60 L
W189327	133.0	216.	0.38	477	4.1	21.6	41.4 L	75.6	27.0	61 L	91
W189328	40.5	41.1	0.42	252	3.3	19.6	43.01 L	48.6	17.7	64 L	255
SITE 8											
W189329	42.5	34.3	0.45	454	7.6	9.18	42.64 L	38.0	12.1	63 L	185
W189330	68.0	209.	0.38	364	4.4	24.5	41.81 L	55.5	23.6	62 L	50 L
W189331	63.0	38.6	0.42	221	2.1	15.6	56.12	41.4	16.6	63 L	201
SITE 9											
W189332	14.0	9.9	0.19	893	9.4	3.17 L	45.63 L	22.8	9.9 L	67 L	31 L
W189333	2.0 L	29.5	0.13 L	222	37.7	7.62	37.67 L	163.8	14.7	56 L	128
W189334	107.0	174.	0.36	457	6.7	14.6	42.04 L	53.9	27.4	62 L	80
W189335	59.0	37.2	0.45	214	3.3	16.7	53.94	54.9	19.5	63 L	205
SITE 10											
W191101	30.3	25.3	0.36	451	6.9	9.92	41.49 L	57.7	108.2	61 L	93
W191102	30.0	36.8	0.45	114	1.9 L	9.65	45.6	44.7	36.8	60 L	183
SITE 11											
W191103	40.0	70.3	0.4	193	2.1 L	13.5	44.3 L	32.7	9.63 L	65 L	120
W191104	68.0	309.	0.57	28	2.0 L	12.7	68.2	44.5	27.2	62 L	148

Table 3a.—Major-, minor-, and trace element composition of 41 coal associated samples from Illinois reported on a whole-rock basis.—Continued

Sample Number	La	Li	Lu	Mn	Mo	Nb	Nd	Ni	Pb	Pr	Rb
SITE 13											
W191105	74.0	432.	0.44	65	7.9	10.58	50.3	48.5	361.6	60 L	63
W191106	39.0	351.	0.4	72	9.8	8.16	37.5 L	58.7	122.4	55 L	71
SITE 14											
W194841	39.0	28.6	0.5	85	78.1	4.49	29.9 L	266.9	18.2	44 L	109
W194842	46.0	21.9	0.51	173	2.0 L	17.35	60.3	45.6	10.9	62 L	224
SITE 15											
W194843	47.0	38.2	0.57	334	2.1 L	12.4	43.9 L	41.0	9.5 L	65 L	146
W194844	43.0	22.9	0.53	119	2.0 L	14.64	55.8	50.3	14.6	62 L	269
W194847	78.0	156.	0.41	58	1.7 L	15.6	56.9	63.9	18.7	78 L	64
SITE 16											
W194845	43.5	21.9	0.58	115	27.6	5.69	26.4 L	287.5	9.2	39 L	90
W194846	35.5	29.9	0.46	136	2.0 L	9.96	41.6 L	63.3	14.5	62 L	203
W194848	26.0	13.8	0.2	1150	1.7	2.21	46.1	14.7	13.8	31 L	37 L

Table 3a.—Major-, minor-, and trace element composition of 41 coal associated samples from Illinois reported on a whole-rock basis.—Continued

Sample Number	Sb	Sc	Se	Sm	Sn	Sr	Ta	Tb	Th	Tl	Tm
SITE 1											
D176926	8.7	11.8	119.0		N	N	89	N	N	113.4	N
D176927	0.4	6.51	13.0		N	N	46	N	B	11.24	N
D176928	1.0	17.2	2.4		N	N	129	N	B	17.96	N
SITE 2											
D176929	1.9	18.3	6.4		N	N	274	N	N	26.23	N
D176930	0.3	5.68	7.3		N	N	40	N	B	12.19	N
D176931	0.7	18.4	1.4		N	N	138	N	B	26.46	N
SITE 3											
D176932	0.1 L	8.36	19.0		N	N	125	N	B	N	N
D176933	0.1 L	8.99	7.4		N	N	30	N	B	5.8	N
D176934	0.8	17.9	1.6		N	N	135	N	B	23.55	N
SITE 4											
D176935	0.5	9.65 L	0.1 L		N	N	68	N	B	14.08	N
D176936	1.0	24.5	0.9		N	N	164	N	B	24.31	N
D176937	0.7	27.8	0.7		N	N	278	N	B	20.46	N
SITE 5											
D176938	5.5	18.9	3.8		N	N	95	N	B	23.15	N
D176939	0.5	9.9	9.0		N	N	66	N	B	29.0	N
D176940	0.7	19.3	1.8		N	N	145	N	B	28.5	N
SITE 6											
W189324	2.2	11.0	7.2	6.6	4.54 L	113	0.48	1.01	8.7	6.67 L	3.07 L
W189325	1.65	10.8	3.7	5.7 L	7.06	166	0.68	0.81	9.3	8.72 L	4.01 L
SITE 7											
W189326	4.3	14.3	45.7	9.6	5.66 L	191	0.73	1.16	10.5	8.32 L	3.83 L
W189327	0.61	9.29	7.2	6.6	6.12 L	738	1.3	0.43	15.4	9.0 L	4.14 L
W189328	0.82	16.7	1.05	6.55	6.36 L	252	1.12	0.86	13.5	9.35 L	4.3 L
SITE 8											
W189329	2.96	17.4	4.5	4.9	6.3 L	139	0.85	0.55	11.2	9.27 L	4.26 L
W189330	0.57	10.2	7.3	5.8	6.18 L	191	1.3	0.68	16.2	9.09 L	4.18 L
W189331	1.08	15.9	1.1	7.5	6.26 L	212	0.91	0.85	11.7	9.2 L	4.23 L
SITE 9											
W189332	1.11	3.71	3.85	2.05	6.75 L	397	0.15	0.28	1.9	9.92 L	4.56 L
W189333	0.41 L	9.63	34.1	0.2 L	12.29	197	0.76	1.54	8.9	8.19 L	3.77 L
W189334	1.08	9.41	11.1	8.4	6.22 L	366	1.22	0.73	15.1	9.14 L	4.2 L
W189335	0.88	16.2	0.75	8.8	6.32 L	233	1.07	1.07	13.8	9.3 L	4.28 L
SITE 10											
W191101	2.17	11.3	5.7	5.9	6.13 L	235	0.8	0.8	9.7	9.02 L	4.15 L
W191102	1.31	16.9	6.7 L	5.5	5.96 L	114	1.53 L	1.62 L	B	8.77 L	4.03 L
SITE 11											
W191103	0.51	18.1	0.5	5.9	6.55 L	144	1.13	0.97	14.1	9.63 L	4.43 L
W191104	1.1	20.3	7.5 L	7.0	6.18 L	200	1.21	0.77	17.4	9.09 L	4.18 L

Table 3a.--Major-, minor-, and trace element composition of 41 coal associated samples from Illinois reported on a whole-rock basis.--Continued

Sample Number	Sb	Sc	Se	Sm	Sn	Sr	Ta	Tb	Th	Tl	Tm
SITE 13											
W191105	2.08	13.5	7.30	7.60	6.0 L	82.0	1.37	.68	19.0	8.82 L	4.06 L
W191106	1.0	10.4	6.7	4.97	5.5 L	90.06	1.50	.58	17.4	8.16 L	3.75 L
SITE 14											
W194841	16.25	12.2	179.	9.2	4.43 L	91	0.69	1.2	9.1	6.51 L	2.99 L
W194842	0.8	17.5	B	6.6	6.21 L	164	1.14	0.88	13.8	9.13 L	4.2 L
SITE 15											
W194843	0.9	17.8	0.26	6.3	6.49 L	134	0.86	0.91	11.6	9.54 L	4.39 L
W194844	1.0	18.	1.46 L	7.3	6.22 L	220	1.01	0.56	14.1	7.8 L	3.59 L
SITE 16											
W194845	7.5	10.8	89.38	6.7	3.91 L	121	0.44	0.82	7.6	5.75 L	2.65 L
W194846	1.3	16.9	0.83	5.2	6.15 L	217	1.0	0.66	12.3	9.05 L	4.16 L
W194848	0.5	3.89	2.63	4.1	3.96	290	0.16	0.5	2.9	4.61 L	2.12 L

Table 3a.--Major-, minor-, and trace element composition of 41 coal associated samples from Illinois reported on a whole-rock basis.--Continued

Sample Number	U	V	W	Y	Yb	Zn	Zr
SITE 1							
D176926	94.1	887	N	89	5.9	1970	89
D176927	1.61	46	N	20	N	23	3
D176928	2.38	86	N	26	2.6	158	172
SITE 2							
D176929	20.1	137	N	64	4.6	200	137
D176930	1.05	40	N	11	N	19	57
D176931	2.53	138	N	28	2.8	112	184
SITE 3							
D176932	9.54	59	N	25	N	30	125
D176933	0.96	30	N	12	N	25	42
D176934	3.12	135	N	45	2.7	263	135
SITE 4							
D176935	1.83	48	N	29	2.9	30	290
D176936	3.52	164	N	41	2.5	54	123
D176937	2.72	186	N	46	2.8	127	139
SITE 5							
D176938	3.28	190	N	32	1.9	86	127
D176939	2.96	66	N	33	2.0	55	99
D176940	2.1	145	N	29	2.9	72	145
SITE 6							
W189324	7.88	80	2.11 L	7	2.4	33	37
W189325	4.51	58	1.65 L	8	1.9	29	44
SITE 7							
W189326	43.4	200	1.37	26	4.1	566	83
W189327	3.09	46	2.07	9	2.0	28	135
W189328	5.0	91	1.62	18	2.3	30	150
SITE 8							
W189329	10.3	93	1.5	9	2.1	36	59
W189330	3.16	53	2.28	11	2.2	15	200
W189331	3.88	74	1.36	19	2.1	27	129
SITE 9							
W189332	8.89	24	1.29 L	13	0.9	21	33
W189333	103.	164	2.4 L	26	4.0	573	68
W189334	3.02	47	2.82 L	10	2.5	13	137
W189335	7.04	77	1.97	16	2.5	25	195
SITE 10							
W191101	12.1	71	1.88	25	2.0	35	135
W191102	2.81	74	2.39	16	2.2	36	105
SITE 11							
W191103	3.63	96	2.69	16	2.1	69	144
W191104	3.88	145	3.46	23	3.4	109	145



Table 4.—Proximate and ultimate analyses, calorific value, forms of sulfur, free-swell index and ash-fusion temperature determinations for 92 bituminous coal bench samples from Illinois.  
 [All analyses except calorific value, free-swell index and ash-fusion temperatures in percent.  
 All analyses by Coal Analysis Section, Department of Energy, Pittsburgh, Pa. G for ash-fusion temperatures means greater than. Sample number is the USGS laboratory number.]

SAMPLE NUMBER	CALORIFIC VALUE (BTU/LB)	ASH FUSION TEMPERATURE, C				---FORMS OF SULFUR---				AIR-DRIED LOSS (% WT.)
		INITIAL DEFORMATION	SOFTENING	FLUID SWELLING	FREE INDEX	SULFATE	PYRITIC (% WT.)	ORGANIC		
SITE 1										
D176941	12440	1980	2130	2205	1	0.23	0.52	2.25		B
D176942	11810	1950	2000	2060	3	0.22	0.55	2.45		B
D176943	11300	1905	1970	2000	1	0.67	1.43	2.22		B
D176944	10450	1990	2040	2090	0.5	0.63	2.1	2.72		B
D176945	10760	2140	2190	2240	1.5	0.14	0.67	2.06		B
D176946	10500	1910	1940	1970	1.5	1.5	2.4	2.49		B
SITE 2										
D176948	11320	1780	1820	1860	1	0.64	1.08	2.31		B
D176949	10990	1870	1900	1930	1.5	0.5	1.77	2.24		B
D176950	10120	2050	2100	2150	0.5	0.46	1.2	1.98		B
D176951	11010	2110	2140	2170	1.5	0.39	0.44	2.25		B
D176952	10130	1970	2000	2030	0.5	0.74	1.29	2.24		B
D176953	9890	1930	1970	2010	0.5	1.71	1.86	2		B
SITE 3										
D176954	11950	2100	2130	2160	2.5	0.01	0.16	2.51		B
D176955	11010	2050	2100	2150	1	0.38	0.72	2.13		B
D176956	11190	2035	2115	2190	1	0.25	0.92	1.82		B
D176957	10490	1970	2000	2030	2.5	1.34	1.45	2.68		B
SITE 4										
D176958	12090	1935	2010	2205	1	0.35	1.6	0.69		B
D176959	11610	2130	2180	2230	2.5	0.26	0.63	1.92		B
D176960	10420	2140	2190	2240	1	0.13	2.24	0.68		B
D176961	11570	2180	2250	2340	1.5	0.17	1	0.82		B
D176962	10920	2570	2620	2890	1.5	0.01	0.23	0.74		B
D176963	12610	2090	2140	2190	2	0.01	0.07	0.85		B
D176964	12350	2090	2140	2190	2.5	0.04	0.14	0.77		B
SITE 5										
D176965	13080	1975	2155	2275	1	0.02	0.11	0.44		B
D176966	12500	2005	2040	2065	1	0.04	0.37	0.37		B
D176967	12800	2155	2315	2470	1	0.02	0.31	0.34		B
D176968	12320	2330	2380	2430	1.5	0.01	0.05	0.44		B
D176969	11810	2630	2680	2730	1.5	0	0.02	0.44		B
D176970	12270	2300	2360	2420	2	0.01	0.16	0.6		B
SITE 6										
W189298	11800	1930	2060	2200	1	0.39	1.96	1.56		B
W189299	12090	1940	1990	2040	2	0.28	2.15	2.23		B
W189300	11400	1940	1990	2050	1.5	1.2	2.96	1.8		B
W189301	11330	1960	2010	2060	1.5	0.61	2.73	2.1		B
W189302	11200	2105	2210	2305	1	0.19	0.66	1.95		B

Table 4.—Proximate and ultimate analyses, calorific value, forms of sulfur, free-swelling index and ash-fusion temperature determinations for 92 bituminous coal bench samples from Illinois.—Continued

SAMPLE NUMBER	CALORIFIC VALUE (BTU/LB)	ASH FUSION TEMPERATURE, C				-----FORMS OF SULFUR----- (% WT.)				AIR-DRIED LOSS (%WT.)	
		INITIAL DEFORMATION	SOFTENING	FLUID	FREE SWELLING INDEX	SULFATE	PYRITIC	ORGANIC			
SITE 7											
W189303	12340	1915	1970	2000	1.5	0.22	1.92	1.46	B		
W189305	12440	2100	2150	2200	3	0.03	0.28	2.01	B		
W189306	9780	2800 G	2910 G	2910 G	0	0.08	0.4	2.07	B		
W189307	11250	1890	1965	2015	1	0.34	1.85	1.7	B		
W189308	11500	2195	2375	2485	1	0.16	0.74	1.8	B		
W189309	11130	1980	2030	2130	1.5	0.69	0.74	5.08	B		
SITE 8											
W189310	12300	1920	1970	2000	1	0.22	1.17	2.05	B		
W189311	11890	2040	2080	2120	2.5	0.11	0.68	2.02	B		
W189312	11610	2120	2170	2270	2	0.08	0.74	1.81	B		
W189313	11110	1950	2000	2050	1.5	0.7	2.73	1.77	B		
SITE 9											
W189314	12280	2080	2130	2180	2.5	0.08	0.75	1.97	B		
W189315	12270	2060	2140	2200	1	0.22	0.71	1.95	B		
W189316	11820	2140	2190	2410	1.5	0.21	0.68	1.95	B		
W189317	11300	2120	2170	2420	1.5	0.16	1.1	1.78	B		
W189318	10810	2080	2130	2250	1.5	0.58	2.01	1.75	B		
W189319	10650	1950	2000	2050	1.5	0.84	3.39	1.68	B		
SITE 10											
W191079	12875	2030	2110	2195	4.5	0	0.9	4.4	0.7		
W191080	12188	2060	2170	2265	5	0	1.1	1.7	2.4		
W191081	12494	1995	2080	2155	4.5	0	1.4	1.5	0.6		
W191082	13090	1930	2015	2115	5	0.08	0.92	2.11	B		
W191083	12179	2050	2180	2260	3	0	1.5	1.4	0.6		
W191084	10989	2080	2185	2260	1.5	0	2.2	1.4	0.7		
SITE 11											
W191085	12661	1965	2055	2120	1	0.5	1.3	1.2	1.2		
W191086	12681	1915	1980	2010	2.5	0.5	1.5	1.2	0.8		
W191087	13187	1950	2025	2080	2	0.2	1.7	0.8	0.6		
W191089	12962	1975	2040	2085	5	0.5	1.1	1	0.9		
SITE 12											
W191088	12502	2155	2255	2355	3.5	0	0.2	1.7	0.7		
W191090	12587	2085	2160	2245	2.5	0	0.2	2.1	0.8		
W191091	11640	1880	1955	2000	4.5	0.1	4.89	1.25	B		
W191092	11610	1880	1960	2000	4.5	0.02	4.32	1.54	B		
W191093	11790	2000	2075	2145	3	0.02	1.42	1.23	B		
W191094	11581	2060	2155	2235	4.5	0.1	0.7	1.7	0.9		
SITE 13											
W191095	11840	1905	1990	2045	1	0.26	3.69	0.75	B		
W191096	12210	1925	2005	2070	1	0.06	1.41	1.36	B		
W191097	12610	1930	2020	2095	2.5	0.03	1.41	1.29	B		
W191098	4190	2800 G	2910 G	2910 G	B	0.12	1.1	0.34	B		
W191099	9940	2200	2305	2405	1	0.02	2.37	1.27	B		
W191100	10170	1840	1930	1995	1.5	0.02	7.51	0.94	B		



Table 4.—Proximate and ultimate analyses, calorific value, forms of sulfur, free-swelling index and ash-fusion temperature determinations for 92 bituminous coal bench samples from Illinois.

SAMPLE NUMBER	CALORIFIC VALUE (BTU/LB)	ASH FUSION TEMPERATURE, C				-----FORMS OF SULFUR----- (% wt.)				AIR-DRIED LOSS (% wt.)
		INITIAL DEFORMATION	SOFTENING	FLUID SWELLING INDEX	FREE SWELLING INDEX	SULFATE	PYRITIC	ORGANIC		
SITE 14										
W192923	12648	2155	2265	2405	4.5	0	0.6	2.1	1.6	
W192924	B	1960	2045	2125	4.5	0	0.93	2.17	1.8	
W192925	12099	1975	2080	2165	6	0.1	1.3	2	2.2	
W192926	12167	2215	2305	2405	5	0	0.5	2.1	2.5	
W192927	11372	2105	2185	2285	5.5	0.1	1.9	1.9	1.9	
W192928	11712	1935	2010	2105	5.5	0.27	2.28	1.76	2	
SITE 15										
W192929	11429	2010	2125	2210	5	0.78	6.23	1.66	1.7	
W192930	12131	1915	2005	2070	5	0.16	2.96	1.54	2.9	
W192931	12177	2120	2210	2300	5.5	0.1	1	1.74	2.7	
W192932	11469	1975	2070	2120	4	0.18	1.28	1.68	3.7	
W192933	11175	2195	2280	2365	4.5	0.16	0.95	1.64	2.7	
W192934	11386	1960	2045	2095	4	0.52	3.05	1.56	1.9	
SITE 16										
W192935	10884	1985	2070	2160	4	0.15	1	2.46	7.4	
W192936	10911	2215	2300	2400	4.5	0.1	1	1.8	7.5	
W192937	10190	1960	2030	2095	1	0.6	1.95	2.06	7.1	
W192938	10426	2150	2235	2330	3	0	0.65	2.33	7.4	
W192939	10171	1910	1980	2080	0	0.91	2.08	2.73	5.5	
W192940	10031	1935	2010	2105	1	0.92	2.03	2.51	6.4	

Table 4.--Proximate and ultimate analyses, calorific value, forms of sulfur, free-swelling index and ash-fusion temperature determinations for 92 bituminous coal bench samples from Illinois.--continued  
[All analyses except calorific value, free-swelling indexes and ash-fusion temperatures in percent.  
All analyses by Coal Analysis Section, Department of Energy, Pittsburgh, Pa. G for ash-fusion temperatures means greater than. Sample number is the USGS laboratory number.]

SAMPLE NUMBER	---PROXIMATE ANALYSIS---				---ULTIMATE ANALYSIS---				
	AS-RECEIVED MOISTURE	VOLATILE MATTER	FIXED CARBON	ASH	HYDROGEN	CARBON	NITROGEN	OXYGEN	SULFUR
SITE 1									
DL176941	6.4	40.9	43.8	8.9	5.9	68.4	0.8	13	3
DL176942	10.2	39.4	44.9	5.5	5.7	66.5	1.2	17.9	3.2
DL176943	8.5	35.7	47.4	8.4	5.5	62.5	0.9	18.4	4.3
DL176944	10.5	33.8	44.1	11.6	5.1	58.8	1.1	18	5.4
DL176945	10.6	34.4	43.2	11.8	5.3	61.2	1.1	17.7	2.9
DL176946	7.5	36.9	44.8	10.9	4.6	59.5	0.9	17.7	6.4
SITE 2									
DL176948	8.1	37.1	46.9	7.9	5.6	63.8	0.5	18.2	4
DL176949	8.1	33.5	48.5	9.9	5.2	61.9	1	17.5	4.5
DL176950	11.3	31.4	43.8	13.5	4.9	58.1	1.1	18.8	3.6
DL176951	7.4	32.3	49.8	10.5	5.2	62.5	0.9	17.8	3.1
DL176952	8	31.7	45.2	15.1	4.9	57.1	0.8	17.8	4.3
DL176953	8.9	34.5	42.4	14.2	4.9	55.7	1	18.6	5.6
SITE 3									
DL176954	5.6	38.1	48.3	8	5.5	67.2	1.1	15.5	2.7
DL176955	11.5	35.2	44.8	8.5	5.4	62.2	1.2	19.5	3.2
DL176956	7.7	34.5	49.7	8.1	5.3	62.2	0.9	20.5	3
DL176957	7.3	34.4	47.5	10.8	5.6	58.6	0.9	19.6	5.5
SITE 4									
DL176958	4.1	35.2	51	9.7	5.2	68	1.1	13.4	2.6
DL176959	6.2	33.6	48.2	12	5.1	65.6	1.4	13.1	2.8
DL176960	7	31.3	42.9	18.8	4.8	59.2	1.3	12.9	3
DL176961	8.6	31.4	49.8	10.2	5.2	66.3	1.4	14.9	2
DL176962	6.4	29	48.9	15.7	4.9	62.1	0.7	15.6	1
DL176963	5.2	34.6	53.4	6.8	5.1	71.7	1.6	13.9	0.9
DL176964	4.7	35.1	50.9	9.3	5.2	69.7	1.5	13.4	0.9
SITE 5									
DL176965	6.2	32.9	58.5	2.4	5.6	73.6	1.1	16.7	0.6
DL176966	6.2	31.1	57.8	4.9	5.3	72.3	0.9	15.8	0.8
DL176967	6.7	30.7	58.4	4.2	5.5	72.7	0.8	16.1	0.7
DL176968	6.5	32.3	53.9	7.3	5.1	70.9	1.5	14.7	0.5
DL176969	4.9	31.9	51.5	11.7	4.9	67.5	1.6	13.8	0.5
DL176970	5.2	32.3	54.6	7.9	5.3	69.7	1.2	15.1	0.8
SITE 6									
W189298	3.5	36.9	48.4	11.2	5.1	65.9	1	12.9	3.9
W189299	5.5	36.8	49.8	7.9	5.1	68.4	1.2	12.7	4.7
W189300	5.6	35	48.6	10.8	4.9	63	1.1	14.2	6
W189301	5.2	37.4	45.3	12.1	4.9	63.4	1.1	13.1	5.4
W189302	3.4	33.4	47.3	15.9	4.8	63	1.2	12.3	2.8

Table 4.--Proximate and ultimate analyses, calorific value, forms of sulfur, free-swelling index and ash-fusion temperature determinations for 92 bituminous coal bench samples from Illinois.--continued

SAMPLE NUMBER	-----PROXIMATE ANALYSIS-----				-----ULTIMATE ANALYSIS-----				
	AS-RECEIVED MOISTURE	VOLATILE MATTER	FIXED CARBON	ASH	HYDROGEN	CARBON	NITROGEN	OXYGEN	SULFUR
SITE 7									
W189303	4.1	34.9	54	7	5.1	69.3	1.1	13.9	3.6
W189305	6	39.2	49.6	5.2	5.5	70.7	1.3	15	2.3
W189306	3.6	27.3	44.8	24.3	4.2	56.5	0.9	11.5	2.6
W189307	7.2	32.7	49.7	10.4	4.9	63.5	1.2	16.1	3.9
W189308	4.4	34.2	49.3	12.1	4.9	65	1.2	14.1	2.7
W189309	3.8	34.9	48.1	13.2	4.6	62.9	1.2	11.6	6.5
SITE 8									
W189310	5.5	37.1	51	6.4	5.4	68.8	0.9	15.1	3.4
W189311	4.5	36.2	50.2	9.1	4.9	67.5	1.2	14.5	2.8
W189312	4.9	36.7	47.1	11.3	4.9	65.5	1.3	14.4	2.6
W189313	6.1	35.9	46.8	11.2	4.9	62.5	1.1	15.1	5.2
SITE 9									
W189314	5.7	38.5	49	6.8	5.4	69.2	1.2	14.6	2.8
W189315	4.7	38.5	49.8	7	5.3	68.8	1.1	14.9	2.9
W189316	4.5	36.5	49.6	9.4	5	67.4	1.3	14.1	2.8
W189317	4	34.7	47	14.3	4.7	64	1.2	12.8	3
W189318	3.5	35.1	45.4	16	4.7	61.2	1.2	12.6	4.3
W189319	5.6	35.6	44.7	14.1	4.7	59	1.2	15.1	5.9
SITE 10									
W191079	3.1	37.4	53	6.5	5.4	71.7	1.2	10	5.3
W191080	5.4	35.5	51.1	8	5.2	68.2	1.2	14.5	2.9
W191081	3.1	35.2	53.1	8.6	5.2	69.6	1.2	12.6	2.9
W191082	3.6	38.2	54	4.2	5.6	72.5	1.3	13.3	3.1
W191083	3.1	35.1	51.5	10.3	5.1	68	1.3	12.4	2.9
W191084	3.2	31.5	47.4	17.9	4.6	61.6	1.1	11.2	3.6
SITE 11									
W191085	4.2	37	52.9	5.9	5.5	70.3	1.4	14	3
W191086	3.7	37.9	52.2	6.2	5.4	70.4	1.3	13.5	3.2
W191087	2.8	31.1	60.7	5.4	4.6	76.2	1.1	10	2.8
W191088	2.8	37.1	50	10.1	5.3	69.9	1.4	11.5	1.9
W191089	4	38	53.5	4.5	5.6	72.1	1.4	13.7	2.7
SITE 12									
W191090	3	37.3	50.4	9.3	5.3	70.2	1.3	11.7	2.3
W191091	2.8	37.4	45.6	14.2	5	63.6	1.2	9.8	6.2
W191092	2.6	37	45.5	14.9	5	63.7	1.2	9.3	5.9
W191093	2.9	37	46.3	13.8	5.1	66	1.2	11.2	2.7
W191094	3.3	35.2	46.9	14.6	4.8	64.5	1.2	12.5	2.5
SITE 13									
W191095	3.7	37.1	48.6	10.6	5.1	65.4	1.1	13.1	4.7
W191096	4.1	37.7	50.2	8	5.3	68.4	1.2	14.3	2.8
W191097	3.7	39.6	50.9	5.8	5.5	70.4	1.3	14.3	2.7
W191098	2.8	20.3	16	60.9	2.8	24.4	0.5	9.9	1.5
W191099	3.6	33	40.1	23.3	4.5	55.9	1.1	11.5	3.7
W191100	3.5	33.2	42.5	20.8	4.4	55.1	1	10.2	8.5

Table 4.--Proximate and ultimate analyses, calorific value, forms of sulfur, free-swelling index and ash-fusion temperature determinations for 92 bituminous coal bench samples from Illinois.--continued

SAMPLE NUMBER	-----PROXIMATE ANALYSIS-----				-----ULTIMATE ANALYSIS-----				
	AS-RECEIVED MOISTURE	VOLATILE MATTER	FIXED CARBON	ASH	HYDROGEN	CARBON	NITROGEN	OXYGEN	SULFUR
SITE 14									
W192923	4.7	38.3	48.7	8.3	5.5	69.9	1.5	12.1	2.7
W192924	5.6	37.6	46.7	10.1	5.2	68	1.4	12.2	3.1
W192925	5.7	37.4	46.9	10	5.1	67.4	1.4	12.7	3.4
W192926	5.8	35	49.4	9.8	5.2	68	1.4	13	2.6
W192927	5.3	34.6	45.2	14.9	4.9	62.8	1.4	12.2	3.9
W192928	5.6	34	48.3	12.1	4.9	65.3	1.4	12.1	4.3
SITE 15									
W192929	4.4	36.8	45.2	13.6	4.9	61.2	1.3	10.4	8.7
W192930	5.6	35.5	49.4	9.5	5.2	67	1.3	12.2	4.7
W192931	7	35.1	49.6	8.3	5.1	68.3	1.4	14.1	2.8
W192932	6.8	32.8	47.3	13.1	4.9	64.6	1.2	13	3.1
W192933	6.6	33.4	44.9	15.1	5	62.3	1.3	13.6	2.8
W192934	6.3	33.6	47.6	12.5	4.9	63.3	1.2	12.9	5.1
SITE 16									
W192935	11.8	35.6	43.4	9.2	5.6	61.2	1.1	19.4	3.6
W192936	11.7	34.8	43.7	10.2	5.5	60.8	1.2	19.5	2.9
W192937	12.1	32	43	12.9	5.2	56.8	1.1	19.4	4.6
W192938	11.8	34.2	40.8	13.2	5.4	58.3	1.1	19	3
W192939	11.1	32.9	43.3	12.7	5.2	56.6	1.1	18.8	5.7
W192940	11.1	32.5	43.3	13.1	5.1	55.5	1.1	19.7	5.5

Table 5.--Arithmetic mean, observed range of ash yields and concentrations of 10 major and minor oxides in the laboratory ash of 16 weighted average samples of Illinois coal.

[All USGS samples were ashed at 515 °C; all data are in percent, -- indicate no data, Illinois samples are recalculated to an ash basis.]

Parameter	Arithmetic mean	Observed range		Arithmetic mean Gluskoter 1977 114 Illinois samples
		Minimum	Maximum	
(Ash)	14.2	1.7	48.1	11
SiO <sub>2</sub>	39	2	66	46.7
Al <sub>2</sub> O <sub>3</sub>	20	.6	36	20.6
CaO	2.5	.06	30	8.6
MgO	.7	.02	2.7	.76
Na <sub>2</sub> O	.3	.01	1.3	.61
K <sub>2</sub> O	1.8	.01	4.5	1.86
Fe <sub>2</sub> O <sub>3</sub>	25	2	83	26
TiO <sub>2</sub>	.9	.04	1.9	.91
P <sub>2</sub> O <sub>5</sub>	.3	.01	3.9	.13
SO <sub>3</sub>	2.5	.23	26	--

Table 5a.--Arithmetic mean and observed range of concentrations of trace elements in 16 weighted average coal samples from Illinois. [All data are in parts-per-million and are reported on a whole-coal basis; -- indicate no data.]

Element	Arithmetic mean	Observed range		Arithmetic mean Gluskoter 1977 114 Illinois samples
		Minimum	Maximum	
AG	0.1	0.01	.95	0.03
AS	20	.1	950	14
B	110	12	210	110
BA	57	2.0	660	100
BE	3.4	.25	9.2	1.7
BR	4.3	.9	23	13
CD	.45	.01	9	2.2
CE	23	2.0	160	14
CO	9.7	.9	110	7.3
CR	21	3.1	81	18
CS	1.4	.2	9.4	1.4
CU	20	3.2	240	14
EU	.46	.07	3.6	.26
F	105	13	780	67
GA	6.4	1.2	25	3.2
GD	2.8	.46	15	
GE	12	1.1	59	6.9
HF	.8	.1	5.8	.54
HG	.14	.01	2.4	.2
LA	12	1	89	6.8
LI	20	.67	210	
LU	.15	.01	.73	.09
MN	33	4	500	53
MO	4.5	.2	46	8.1
NB	2.9	.2	14	--
ND	18	1.8	100	--
NI	32	3.3	170	21
PB	23	.73	240	32
RB	28	4	130	19
SB	1.5	.02	15	1.3
SC	4.3	.47	18	2.7
SE	3.6	.5	15	2.2
SM	2.2	.01	15	1.2
SN	1.0	.12	3.3	3.8
SR	60	2.0	730	35
TA	.23	.02	2	.15
TB	.38	.11	2.2	.22
TH	2.8	.3	18	2.1
U	2.5	.11	42	1.5
V	28	.6	150	32
W	.61	.1	5.3	.82
Y	8.8	1.5	69	
YB	.94	.2	8.1	.56
ZN	92	4.3	3300	250
ZR	32	.83	270	47

Table 5b.--Arithmetic mean and observed range, of proximate and ultimate analyses, calorific value, forms of sulfur, and ash-fusion temperature of 16 weighted average coal samples from Illinois.

[All values are in percent except calorific value (Btu/lb), ash-fusion temperatures, and free-swelling index and are reported on the as-received basis.  $F = 9/5 C + 32$ ; Kcal/kg = 0.556 (Btu/lb). -- indicate no data]

	Arithmetic mean	Observed range		Arithmetic mean Gluskoter 1977 114 Illinois samples
		Minimum	Maximum	
-----				
Proximate and ultimate analyses				
-----				
Moisture	9.92	2.1	21.4	9.4
Volatile matter	34.58	22.4	43.5	40
Fixed carbon	45.85	27.3	57.8	49
Ash	9.65	2.0	44.9	11
Hydrogen	5.53	3.5	6.3	5
Carbon	63.10	39.1	73.0	70
Nitrogen	1.18	.5	1.6	1.3
Oxygen	17.47	7.9	31.1	8.2
Sulfur	3.14	.3	7.7	3.6
-----				
Calorific value				
-----				
KCal/KG	6297	3853	7234	7068
Btu/lb	11325	6929	13010	12712
-----				
Forms of sulfur				
-----				
Sulfate	0.33	0.01	1.28	0.1
Pyritic	1.56	.06	6.10	2
Organic	1.23	.15	2.65	1.6
-----				
Ash-fusion temperature °C				
-----				
Initial deformation	1171	1018	1528	--
Softening temperature	1230	1057	1600	--
Fluid temperature	1275	1085	1600	--
-----				
Free-Swelling index	6.94	.4	9	--