ISGS CONTRACT/GRANT REPORT 1986–1

INFORMATION SYSTEM ON ILLINOIS COAL II: Characterization of Samples In the Illinois Basin Coal Sample Program

Richard D. Harvey
Aravinda Kar
John D. Steele

1986

Final Report to the Coal Research Board
Illinois Department of Energy and Natural Resources
through the Center for Research on Sulfur in Coal

Contract 1-5-90190

Illinois Department of Energy and Natural Resources
STATE GEOLOGICAL SURVEY DIVISION

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ILLINOIS STATE GEOLOGICAL SURVEY
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ABSTRACT

Petrographic, mineralogic, and minor and trace element compositions of the first five samples in the Illinois Basin Coal Sample Program (IBCSP) were determined, and an information system for IBCSP was established on a mainframe computer at the University of Illinois. The information is accessible from remote terminals. Proximate, ultimate and other standard test data were already available on the samples. In addition to these data, the information system includes the name, address, sample number, project title, and results or objectives of each researcher using IBCSP samples. To date 156 uniform splits of the samples have been provided to 48 researchers.

The computerized information system is operational. Persons interested in accessing it from their terminals may arrange to do so by contacting the Illinois State Geological Survey.

EXECUTIVE SUMMARY

Characteristic properties--maceral composition, reflectance of vitrinite, pyrite characterization (including pyrite cleanability index), mineral matter composition, and minor and trace element compositions -- were determined on the samples that are part of the Illinois Basin coal sample program (IBCSP). An informational data base comprising these and other data was established on a mainframe computer at the University of Illinois. Other data include the name, address, sample numbers, project title, and objectives or results of each researcher who is using one or more of the IBCSP samples. At this writing 156 uniform splits of the first four samples in the program have been provided to 48 researchers, 34 located in Illinois, the rest in other states and Canada.

Petrographic analyses show that all samples are vitrinite rich (table E1). Expressed on a mineral matter corrected basis, the vitrinite content ranges from 62.3 to 85.7 and the total inertinite content from 3.9 to 8.8 volume percent.

Mineral matter is most abundant in sample 4 (table E2) because it is a mine-run product, which contains some shale from the mine roof. A trace of marcasite, an orthorhombic form of FeS_2, was detected in samples 1, 2, 3, and 5. This has importance because marcasite is more prone to oxidize than pyrite and marcasite may affect certain chemical processes more readily than pyrite.

Sample 2, from the Colchester (No. 2) Coal, contains relatively high concentrations of arsenic, germanium, and lead in comparison with the average for these elements in previously analyzed samples from the Herrin (No. 6) and Springfield (No. 5) Coal seams. Arsenic and lead are associated with sulfide minerals and germanium with organic matter in previously tested samples.

Other important characteristics of the IBCSP samples are:

Sam. no.	Product	Seam	Location	Rank	Ash*	S*	PyS/ OrS
1	Prep plant	IL No. 6	W. Central IL	hvCb	10.3	4.3	0.4
2	Prep plant	IL No. 2	Western IL	hvCb	6.7	3.2	2.5
3	Prep plant	80% IL No. 5 20% IL No. 6	Southern IL	hvBb	8.4	2.3	0.9
4	Mine-run	IL No. 6	Southwestern IL	hvCb	38.1	4.2	1.3
5	Channel	IL No. 6	Southwestern IL	hvCb	18.0	4.6	1.2

* Weight percent, dry basis.

Table E1. Maceral and reflectance analyses*

Sample no.	1	2	3	4	5
Maceral analysis, vol.%					
vitrinite	81.8	85.7	81.2	62.3	76.5
Exinite+	2.5	3.5	3.5	2.0	2.2
Resinite	2.7	2.3	1.7	2.4	0.7
Other liptinite	nil	nil	nil	0.1	nil
Micrinite	1.0	0.7	0.3	1.0	0.9
Macrinite & Scl.	0.4	tr	0.2	0.6	1.1
Semifusinite	1.9	1.8	5.8	1.8	3.4
Fusinite	1.2	0.3	0.7	1.8	2.6
Inertodetrinite	1.1	1.2	1.4	1.1	0.7
Pyrite	1.1	2.7	1.0	3.0	1.8
Other minerals	6.2	1.9	4.2	23.9	9.9
Reflectance of vitrinite (telocollinite) (%)					
mean#	0.46	0.62	0.74	0.67	0.50
std. dev.	0.043	0.050	0.048	0.054	0.034

* Mineral matter corrected according to the ash and sulfur values by the Parr formula. The rounding of decimals causes some columns not to total 100 %.
\+ Sporinte and cutinite are grouped together as exinite.
\# Mean of 100 maximum readings, measured under oil.

Table E2. Mineral composition*

Sample no.	1	2	3	4	5
Mineral matter (low temperature (140°C) ash residue)	13.0	10.0	9.8	43.0	20.9
Quartz	2.6	0.6	1.4	8.0	4.0
Calcite	0.5	2.7	nil	1.6	2.7
Pyrite	2.1	4.0	1.8	4.6	4.2
Kaolinite	3.3	1.0	2.6	6.4	4.1
Illite	2.4	0.8	2.7	9.9	2.5
Expandable	2.1	0.9	1.3	12.5	3.4
Other minerals (detected in minor or trace amounts)+	Marc Anhy Szom	Marc Coq	Marc Szom	Plag Szom	Marc Dol

* Weight percent of coal sample.
\+ Anhy - anhydrite ($CaSO_4$), Coq - Coquimbite ($Fe_2(SO_4)_2(OH)_6$)
Marc - marcasite (FeS_2), Plag - plagioclase (silicate)
Szom - szomolnokite ($Fe_2SO_4.H_2O$), Dol - dolomite ($CaMg(CO_3)_2$)

INTRODUCTION AND BACKGROUND

Much interest has been expressed in the Illinois Basin Coal Sample Program (IBCSP) by researchers being funded by the Illinois Coal Development Board and other coal research groups within and outside Illinois. The program is directed by Dr. Carl W. Kruse, Illinois State Geological Survey. To help the users of the IBCSP and others, this project was initiated with two objectives: 1) determine useful characteristic properties of the samples; and 2) establish a computerized information system (data base) for IBCSP on a computer capable of supporting on-line users at remote terminals. The properties determined are various petrographic, mineralogic, and minor and trace element analyses. These data together with the more standard chemical analyses need to be incorporated in the data base. In addition, the data base should include information about the projects being undertaken by users of the samples. This will promote collaboration among users and help them and others plan future projects using these samples.

ACKNOWLEDGMENTS

This work was sponsored by the Illinois Department of Energy and Natural Resources through the Illinois Coal Development Board. Several ISGS staff members assisted in various tasks: Richard A. Cahill, L. Ray Henderson, Lawrence B. Kohlenberger, Donald J. Lowry, and James J. Miner performed the analyses, and O. Michael Dieter assisted with the computer programming.

PROCEDURES

Petrographic data were determined using the following procedures. A representative split (-20 mesh) of each sample was obtained, mounted in epoxy and polished for determination of reflectance and maceral composition. The methods used followed those described in ASTM (1985): D2797 - for preparation of samples, D2798 - for reflectance measurement, and D2799 - for measurement of maceral composition. The microscopic specimens used for these analyses were also used for pyrite characterization which followed the method of Harvey and DeMaris (1985).

The residue from low temperature ashing (LTA) at about 140°C was used as the best quantitative measure of the total mineral matter content of coal (Harvey et al., 1983). The amount of the various mineral phases in the LTA was determined by quantitative X-ray diffraction methods and the results converted to the whole coal basis.

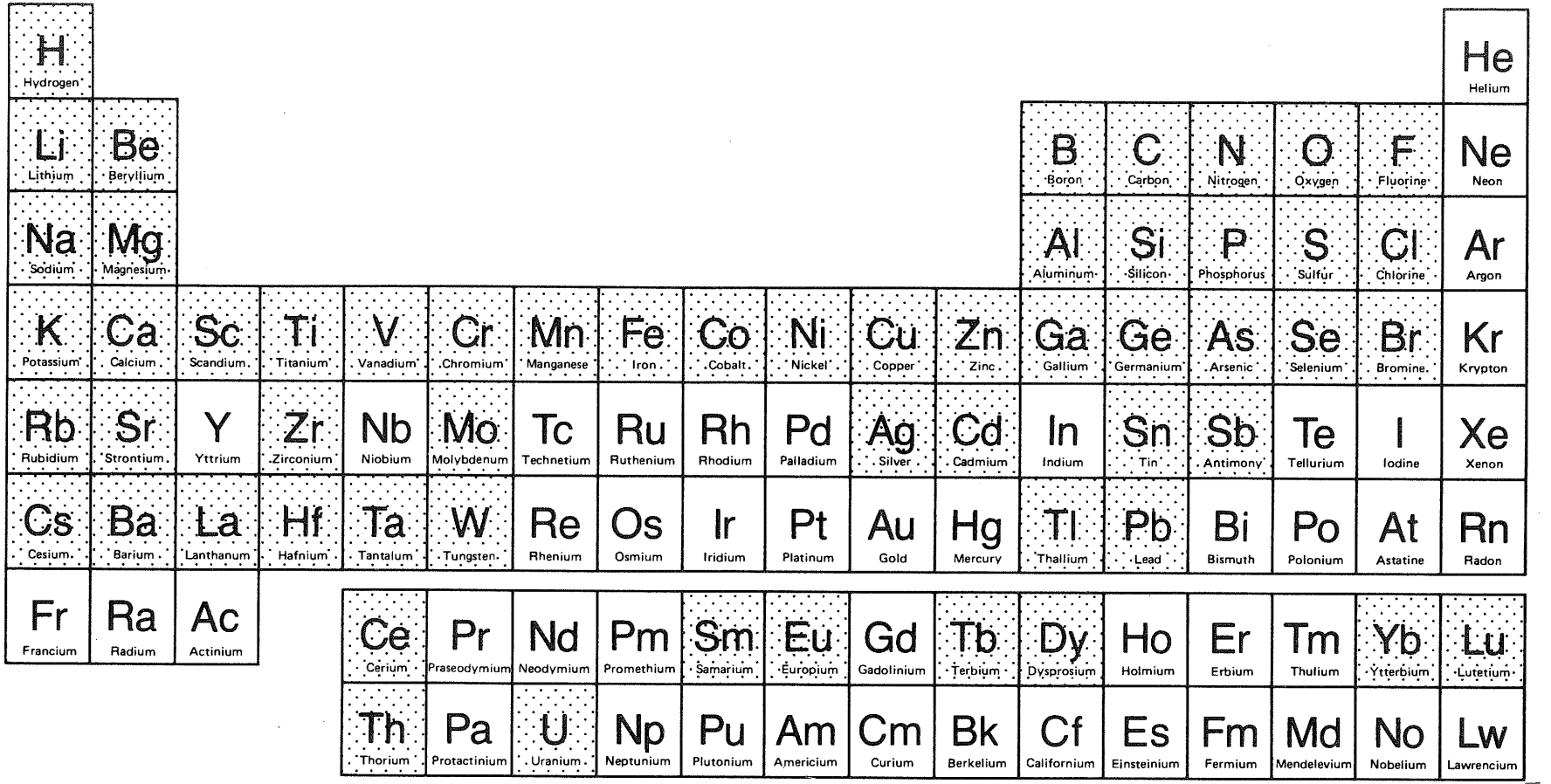

Figure 1. Elements (with dot pattern) for which analytical data were determined.

Concentrations of the minor and trace elements in the samples were determined by the following analytical methods:

Optical emission, photographic-
Ag, B, Be, Ge, Tl, V.

Ion selective electrode-
F

Energy dispersive X-ray-
Ba, Mo, Sn, Sr, Zr.

Wave-length dispersive X-ray-
Al, Ca, Fe, K, P, Si, Ti.

Atomic absorption-
Cd, Cu, Li, Mg, Ni, Pb, Zn.

Instrumental neutron activation-
As, Br, Ce, Co, Cr, Cs, Dy, Eu, Ga, Hf, La, Lu, Mn, Na, Rb, Sb, Sc, Se, Sm, Ta, Tb, Th, U, W, Yb.

These elements together with those determined as part of the ultimate analysis comprise most of the periodic chart (fig.1). The elements not analyzed either have no stable isotopes (Tc, Pm) or they are of much lesser importance. Bismuth, tellurium, and mercury are of some environmental concern and they, together with some of the other remaining elements, should be considered as part of a future project.

The information system was established on the University of Illinois' Cyber-175 computer, in Urbana. The system provides on-line menu options so that users can easily obtain the desired data. The system was established in parallel with the existing information system on chemistry of Illinois coals (Harvey, et al. 1985). The two data bases are set up so that investigators at remote facilities can access one or both during a computer session.

INFORMATION SYSTEM

The information system was designed to handle two types of data. The first contains the name, address, project title, and results or objectives of the researchers using the samples; the second contains the chemical and other characteristic properties of the samples (fig. 2). These properties are listed in more detail in table 1. The system provides those users who have only a terminal and modem the capability to print data at the ISGS for same day mailing to the user. Those users with a computer and communications software can off-load the data to their own facility.

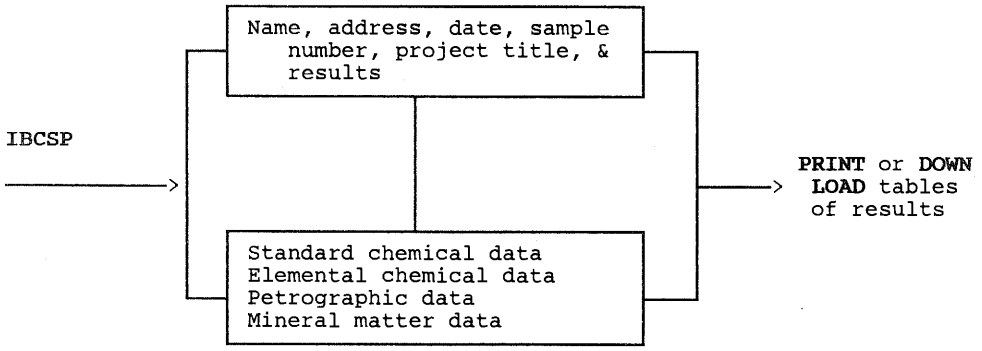

Figure 2. Design of the IBCSP data base.

Table 1. Chemical, petrographic, and mineralogic data available on the coal samples

Standard Chemical Analyses	Minor Elements (reported as oxides)
Proximate analyses	Si, Al, Fe, Mg, Ca, K, Ti, P
Ultimate analyses	Trace Elements
Chlorine	Ag, As, Ba, Be, B, Br, Cd, Ce, Co
Heating value	Cr, Cs, Cu, Dy, Eu, F, Ga, Ge, Hf
Free Swelling Index	La, Li, Lu, Mn, Mo, Na, Ni, Pb,Rb
Gieseler Plasticity	Sb, Sc, Se, Sm, Sn, Sr, Ta, Tb,Th
	Tl, U, V, W, Yb, Zn, Zr
Petrographic Analyses	Mineral Matter Analyses
Maceral analysis	Low Temperature Ash
Reflectance	Pyrite, quartz, calcite, clay
Pyrite Characterization, pyrite cleanability index	Varieties of clay: kaolinite illite, expandable clay (mixed-layered illite/smectite)

User Access

To sign on the computer you must first make telephone connections with the Cyber-175. The telephone number to call depends on the baud rate of your modem:

1-217-333-4000 for 300 baud
1-217-333-4008 for 1200 baud

When telephone connections are established, those using 300 baud need only enter a carriage return <cr>; those using 1200 baud will need to respond to "enter class or help" by entering DNOSA <cr>. The Cyber-175 prompts with "class start", to which you respond with <cr>. On rare occasions all Cyber ports are busy and when this happens, the Cyber gives an opportunity to enter the queue and wait until a port opens. When a port opens, the "READY" prompt is responded to with a <cr>. Don't wait more than 2 or 3 minutes in the queue, but switch off the modem and try again after about 20 minutes. When connection with the Cyber is established, it will prompt for entry of the necessary codes:

You enter*		Note:
SIGNON:	<cr>	Do not
PASSWORD:	<cr>	enter any
RECOVER/CHARGE:	<cr>	spaces

*codes to be provided to users as needed.

You should now be fully logged onto the computer and it prompts for the next entry with a slash, "/".

Data Acquisition Procedure

To start the retrieval program, named IBCSP, enter:

GET,IBCSP/UN=33ISCIC <cr> Note: no spaces are entered
IBCSP <cr>

Further instructions will appear at the terminal screen. A flow chart (fig. 3) summarizes the computer menus and options. The program permits users to read the names of researchers who are using the samples and other related data on the terminal screen, but not the analytical data (fig. 3). However, there is a way to "type" the analytical data to the screen. This can be done by selecting print option 2. This option asks users to give the retrieved file a name--such as the first 6 characters of their institutional name plus a "1" or "2"... This file can then be typed at your screen after you "quit" and get the slash prompt. At that time you enter the sequence given below in item 3.

Sign off the computer by entering "BYE", when prompted with a slash.

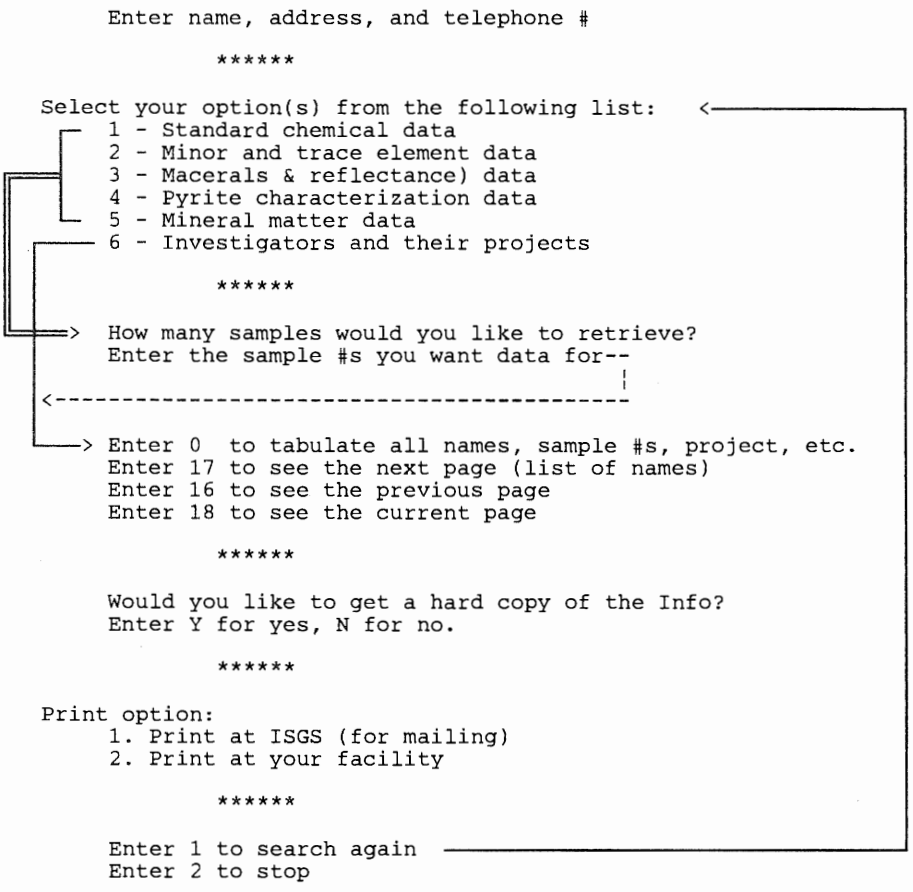

Figure 3. Flow chart for IBCSP data base. Change of terminal screen indicated by *****

If you are connected to the Cyber with only a terminal and want a printed copy of the selected data then print option 1 is selected. This sends a printed copy to the ISGS and it will be mailed to you the same day. If you are connected to the Cyber with a computer and communications software you may off-load the selected data to your own computer by selecting print option 2. You will then be asked to enter a name for the file. You then quit the program and, after the slash prompt is obtained, do the following:

1. Set up your printer to receive the data. The standard chemical and elemental data sets require the printer to print 132 characters per line.

2. Set up your computer so that whatever is typed on your video terminal is echoed to your printer and/or saved on disk.

3. Enter the following (on the Cyber):

```
GET,filename <cr>     Note: this is the
PACK,filename<cr>     filename assigned
TYPE,filename<cr>     earlier in IBCSP
```

After the listing is completed and you select the quit option, you may then sign off the computer by entering "BYE".

Service to Users Without Terminals

Persons without terminals can obtain information free of charge by contacting either the Coal Section or the Minerals Engineering Section of the Illinois State Geological Survey (217/344-1481) or the Center for Research on Sulfur in Coal (217/333-9241), both located in Champaign, Illinois.

RESULTS OF ANALYSES

Standard Chemical Analyses

The results of standard chemical analyses were determined for another project by analysts in the Minerals Engineering Section of the ISGS. We set up these results in a special computer file and wrote a program to provide the mean and typical range on an as-received basis (table 2). The ratio of pyritic to organic sulfur varies among the samples in the sample number order: 2 > 4 > 5 > 3 > 1 (see executive summary). The rank of each sample is high volatile C bituminous, except for sample 3 which is high volatile B.

Minor and Trace Elements

The concentration of the minor and trace elements in the samples is given in table 3. Comparison of the results with the average for the main commercial seams in Illinois indicates sample 4 is

Table 2. Statistics for standard chemical results of samples analyzed on an as received basis

	ANALYSIS	NO. OF SAMPLES	MEAN	TYPICAL RANGE	
Sample 1	MOIS	4	14.1	13.5	14.7
	VOL	3	37.4	37.1	37.7
	FXC	3	39.6	39.3	39.9
	ASH	4	8.9	8.4	9.3
	PYS	3	.97	.81	1.12
	ORS	3	2.43	2.38	2.49
	SUS	1	.10	.10	.10
	TOS	3	3.53	3.48	3.59
	CL	2	.09	.09	.09
	BTU	3	10843	10784	10901
	H	1	5.8	5.8	5.8
	C	1	58.9	58.9	58.9
	N	1	.9	.9	.9
	O	1	22.3	22.3	22.3
Sample 2	MOIS	4	13.5	12.9	14.0
	VOL	3	36.7	36.1	37.3
	FXC	3	43.8	43.1	44.4
	ASH	4	5.9	5.7	6.0
	PYS	3	1.83	1.63	2.04
	ORS	3	.73	.68	.79
	SUS	1	.20	.20	.20
	TOS	3	2.70	2.60	2.80
	CL	NO DATA			
	BTU	3	11739	11665	11813
	H	1	5.9	5.9	5.9
	C	1	62.7	62.7	62.7
	N	1	1.0	1.0	1.0
	O	1	21.8	21.8	21.8
Sample 3	MOIS	4	5.3	5.2	5.5
	VOL	3	37.5	36.7	38.2
	FXC	3	49.3	48.5	50.0
	ASH	4	7.9	7.7	8.0
	PYS	3	.90	.90	.90
	ORS	3	1.07	1.01	1.12
	SUS	1	.10	.10	.10
	TOS	3	2.10	2.10	2.10
	CL	3	.15	.13	.17
	BTU	4	12770	12706	12834
	H	2	5.2	5.2	5.2
	C	2	70.3	69.2	71.4
	N	2	1.5	1.4	1.5
	O	2	12.9	11.6	14.1
Sample 4	MOIS	4	9.9	9.2	10.6
	VOL	3	27.7	27.0	28.4
	FXC	3	27.9	27.3	28.5
	ASH	4	34.3	34.0	34.6
	PYS	4	2.23	1.99	2.46
	ORS	4	1.40	1.13	1.67
	SUS	1	.20	.20	.20
	TOS	4	3.80	3.51	4.09
	CL	4	.05	.02	.08
	BTU	3	7612	7575	7649
	H	3	4.0	4.0	4.0
	C	3	42.6	41.8	43.4
	N	3	.6	.5	.7
	O	3	14.5	13.3	15.7
Sample 5	MOIS	11	9.4	9.1	9.8
	VOL	11	36.6	36.2	37.0
	FXC	11	37.7	37.2	38.3
	ASH	11	16.3	16.0	16.5
	PYS	11	2.21	2.10	2.32
	ORS	11	1.75	1.54	1.97
	SUS	NO DATA			
	TOS	11	4.03	3.86	4.20
	CL	2	.06	.03	.08
	BTU	11	10429	10399	10459
	H	2	4.9	4.8	4.9
	C	2	56.7	54.9	58.5
	N	2	1.0	1.0	1.0
	O	2	17.1	15.1	19.0

notably rich in SiO_2, MgO, Na_2O, F, and Rb. The reason for these high values is the relatively high abundance of mineral matter in this mine-run sample. It should also be noted that sample 2 contains a relatively high amount of As, Ge, and Pb in comparison with the average for Illinois (table 3). Germanium is probably associated with the organic matter in the sample, while As and Pb are probably associated together in grains of pyrite.

Petrographic Analyses

The results of maceral and reflectance analyses of the samples are given in table 4. On a mineral free basis, all are distinctly rich in vitrinite (85.3 to 89.9 vol. %). On this basis, sample 5 is most enriched in inertinite group macerals (10.0 vol. %). The mean maximum reflectance of the samples ranges from 0.46 to 0.74 percent, sample 1 being the lowest and sample 3 the highest. The reflectance results are consistent with the rank of the coals as noted above. Note: the format of table 4, as well as the remaining ones, is essentially the same as the format of the tablulated data that is printed from IBCSP.

The results of pyrite characerization are given in table 5, which comprises quantitative data on the mean size and maceral/mineral association of pyrite grains and the pyrite cleanability index (PCI) for each sample (Harvey and DeMaris, 1985). The mean diameter of pyrite ranges from 4.2 μm (sample 3) to 8.72 μm (sample 4). The results also show a wide range of PCI values for these two samples: 0.25 to 2.19. This index is very much a function of particle size due to increased liberation of pyrite during fine grinding. However, as all the reported values were determined on -20 mesh samples, they can be used to compare the samples one to the other. The PCI data indicate a higher percentage of the pyrite in sample 4 can be cleaned (removed) from this sample than from sample 3 without further grinding. This is consistent with the fact that sample 3 is a product from a preparation plant while sample 4 is a mine-run product. The high PCI for sample 4 is due to the large percentages of free pyrite and pyritic coal in this sample as compared to the others. Sample 5 tested to have the highest index (2.96).

Mineralogic Analyses

The results of mineral analyses are given in table 6. The mine-run sample (sample 4) contains the highest amount of mineral matter (43%). Kaolinite is the predominant clay mineral in samples 1, 2, and 5; and both kaolinite and illite are about equal in abundance in sample 3. The expandable clay mineral, also known as mixed-layed illite/smectite, is most abundant in sample 4.

SAMPLE USERS

The name, address, sample number, project title, and results or objectives of the research work of each of the investigators of IBCSP samples are given in the appendix.

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Harvey, R. D. and P. J. DeMaris, 1985, Size and maceral association of sulfide grains in Illinois coals and their washed products: Final Report, Ill. Coal Research Board, Illinois State Geological Survey Contract/grant Report 1985-2, 49p.

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Table 3. Minor and trace elements

Oxide/element	IBCSP sample number 1	2	3	4	5	Average IL coal*
Minors (%)						
SiO_2	4.6	1.8	4.1	22.1	8.2	5.5
Al_2O_3	1.6	0.9	1.8	6.5	2.9	2.5
Fe_2O_3	1.7	2.8	1.5	3.8	3.4	2.7
MgO	0.09	0.038	0.073	0.529	0.185	0.046
CaO	0.5	0.2	0.1	1.4	1.2	1.0
Na_2O	0.139	0.0182	0.0297	0.337	0.168	0.0987
K_2O	0.21	0.11	0.2	0.99	0.33	0.22
P_2O_5	0.02	0.01	0.03	0.09	0.02	0.02
TiO_2	0.08	0.03	0.09	0.31	0.15	0.11
Traces (ppm)						
Ag	<1	<1	<1	<1	<0.2	0.06
As	2	32	16	5	2.6	11
Ba	32	14	28	135	73	140
Be	1.4	3.3	1.2	2.7	1.0	1.5
B	193	109	71	317	179	118
Br	6	3	12	3	6.5	12
Cd	1.1	0.8	0.1	<0.4	-	1.5
Ce	6	2	10	21	19	14.7
Co	3	6	5	9	3.8	5
Cr	31	7	16	44	19	18
Cs	1.1	0.8	1.2	4	1.9	1.0
Cu	9.7	21.9	8.0	14.4	9.5	12.5
Dy	0.6	1.5	0.9	1.7	-	1.1
Eu	0.2	0.2	0.2	0.5	0.2	0.3
F	63	26	56	460	-	68
Ga	3	3	3	10	3.4	3.9
Ge	<5	30	<5	<5	5	5
Hf	0.4	0.2	0.5	1.7	1.0	0.6
La	4	2	7	16	5.9	7
Li	11.3	18.1	29.9	38.9	8.2	16.3
Lu	0.1	0.1	0.1	0.3	0.08	0.1
Mn	31	16	13	112	71	55
Mo	15	4	13	6	9	9
Ni	11	22	14	23	15	18
Pb	8	149	57	28	6	28
Rb	9	5	11	63	20	16
Sb	0.2	3.4	1.1	0.3	0.3	1.0
Sc	2.1	2.1	2.6	6.4	2.4	2.7
Se	1.5	1.3	2.2	2.2	2.4	2.4
Sm	0.9	0.9	1.4	2.9	1.2	1.4
Sn	<1	<1	<1	1.7	<5	-
Sr	25	12	33	58	29	34
Ta	0.1	0.1	0.1	0.4	0.25	0.2
Tb	0.1	0.2	0.2	0.2	0.13	0.2
Th	1.2	0.7	1.3	3.9	3.2	2.2
Tl	<2	<2	<2	<2	1.0	1.0
U	<2	<1.5	<4	<3	1.2	1.5
V	25	22	26	50	23	31
W	<0.5	<0.5	<0.7	0.9	1.5	0.6
Yb	0.4	0.6	0.5	1.0	0.5	0.6
Zn	172	99.8	45.1	175	77	248
Zr	16	13	23	51	28	35

* Calculated from data on channel samples from the Herrin (No.6) and Springfield (No. 5) Coals (Harvey, et al., 1983).

Table 4. Maceral and reflectance (mean, standard deviation for vitrinite) data

SAMPLE NO. IBCSP-1 SEAM: HERRIN (NO.6) LAB. NO. C22542
LOCATION: WEST CENTRAL ILLINOIS SAMPLE COLLECTED BY MDS, 6-15-83
SAMPLE TYPE: RUN OF PREPARATION PLANT

DATA SET: C22542.A2P

MACERAL/MINERAL	VOLUME PERCENT MEASURED	MINERAL CORRECTED	MINERAL FREE
TOTAL VITRINITE	85.9	81.8	88.3
EXINITE	2.6	2.5	2.7
RESINITE	2.8	2.7	2.9
OTHER LIPTINITE	nil	nil	nil
TOTAL LIPTINITE	5.4	5.1	5.5
MICRINITE	1.1	1.0	1.1
MACRINITE/SCLEROTINITE	0.4	0.4	0.4
SEMIFUSINITE	2.0	1.9	2.1
FUSINITE	1.3	1.2	1.3
INERTODETRINITE	1.2	1.1	1.2
TOTAL INERTINITE	6.0	5.7	6.2
PYRITE	1.1	1.1	
OTHER MINERALS	1.6	6.2	
CALCITE OBSERVED (Y OR N)	N		
OTHER SULFIDES OBSERVED (Y OR N)	N		

TOTAL COUNT: 1000

REFLECTANCE, VITRINITE (TELOCOLLINITE): 0.46 % (MEAN OF 100 MAXIMUM
STANDARD DEVIATION: 0.043 % READINGS UNDER OIL)

ASH: 10.9% TOTAL SULFUR: 4.19% (DRY BASIS)
ANALYST: JJM, DATE OF ANALYSIS: 12-31-85, PROJECT: IBCSP
DESCRIPTION: MACRINITE = 0.2%, SCLEROTINITE = 0.2% (AS MEASURED)

SAMPLE NO. IBCSP-2 SEAM: COLCHESTER (NO.2) LAB. NO. C22543
LOCATION: WESTERN ILLINOIS SAMPLE COLLECTED BY MDS, 7-10-83
SAMPLE TYPE: RUN OF PREPARATION PLANT

DATA SET: C22543.A2P

MACERAL/MINERAL	VOLUME PERCENT MEASURED	MINERAL CORRECTED	MINERAL FREE
TOTAL VITRINITE	86.9	85.7	89.9
EXINITE	3.5	3.5	3.6
RESINITE	2.3	2.3	2.4
OTHER LIPTINITE	nil	nil	nil
TOTAL LIPTINITE	5.8	5.7	6.0
MICRINITE	0.7	0.7	0.7
MACRINITE/SCLEROTINITE	tr	tr	tr
SEMIFUSINITE	1.8	1.8	1.9
FUSINITE	0.3	0.3	0.3
INERTODETRINITE	1.2	1.2	1.2
TOTAL INERTINITE	4.0	3.9	4.1
PYRITE	2.7	2.7	
OTHER MINERALS	0.6	1.9	
CALCITE OBSERVED (Y OR N)	N		
OTHER SULFIDES OBSERVED (Y OR N)	N		

TOTAL COUNT: 1000

REFLECTANCE, VITRINITE (TELOCOLLINITE): 0.62 % (MEAN OF 100 MAXIMUM
STANDARD DEVIATION: 0.050 % READINGS UNDER OIL)

ASH: 6.8% TOTAL SULFUR: 3.17% (DRY BASIS)
ANALYST: JJM, DATE OF ANALYSIS: 01-03-86, PROJECT: IBCSP
DESCRIPTION: BOTH MACRINITE AND SCLEROTINITE WERE OBSERVED IN TRACE AMOUNTS. ISGS

Table 4. *(Continued)*

SAMPLE NO. IBCSP-3 SEAM: SEE NOTE LAB. NO. C22544
LOCATION: SOUTHERN ILLINOIS SAMPLE COLLECTED BY MDS, 11-08-83
SAMPLE TYPE: RUN OF PREPARATION PLANT

NOTE: 80% SPRINGFIELD (NO.5) AND 20% HERRIN (NO.6) SEAMS

DATA SET: C22544.A2P

MACERAL/MINERAL	VOLUME PERCENT MEASURED	MINERAL CORRECTED	MINERAL FREE
TOTAL VITRINITE	84.6	81.2	85.7
EXINITE	3.6	3.5	3.6
RESINITE	1.8	1.7	1.8
OTHER LIPTINITE	nil	nil	nil
TOTAL LIPTINITE	5.4	5.2	5.5
MICRINITE	0.3	0.3	0.3
MACRINITE/SCLEROTINITE	0.2	0.2	0.2
SEMIFUSINITE	6.0	5.8	6.1
FUSINITE	0.7	0.7	0.7
INERTODETRINITE	1.5	1.4	1.5
TOTAL INERTINITE	8.7	8.4	8.8
PYRITE	1.0	1.0	
OTHER MINERALS	0.3	4.2	
CALCITE OBSERVED (Y OR N)	N		
OTHER SULFIDES OBSERVED (Y OR N)	N		

TOTAL COUNT: 1000

REFLECTANCE, VITRINITE (TELOCOLLINITE): 0.74 % (MEAN OF 100 MAXIMUM
STANDARD DEVIATION: 0.048 % READINGS UNDER OIL)

ASH: 8.4% TOTAL SULFUR: 2.19% (DRY BASIS)
ANALYST: JJM, DATE OF ANALYSIS: 01-05-86, PROJECT: IBSCP
DESCRIPTION: NO SCLEROTINITE WAS OBSERVED

SAMPLE NO. IBCSP-4 SEAM: HERRIN (NO.6) LAB. NO. C22545
LOCATION: SOUTHWESTERN ILLINOIS SAMPLE COLLECTED BY JMB, 12-15-83
SAMPLE TYPE: RUN OF MINE

DATA SET: C22545.A2P

MACERAL/MINERAL	VOLUME PERCENT MEASURED	MINERAL CORRECTED	MINERAL FREE
TOTAL VITRINITE	65.2	62.3	85.3
EXINITE	2.1	2.0	2.7
RESINITE	2.5	2.4	3.3
OTHER LIPTINITE	0.1	0.1	0.1
TOTAL LIPTINITE	4.7	4.5	6.2
MICRINITE	1.0	1.0	1.3
MACRINITE/SCLEROTINITE	0.6	0.6	0.8
SEMIFUSINITE	1.9	1.8	2.5
FUSINITE	1.9	1.8	2.5
INERTODETRINITE	1.1	1.1	1.4
TOTAL INERTINITE	6.5	6.2	8.5
PYRITE	3.0	3.0	
OTHER MINERALS	20.6	23.9	
CALCITE OBSERVED (Y OR N)	Y		
OTHER SULFIDES OBSERVED (Y OR N)	N		

TOTAL COUNT: 1000

REFLECTANCE, VITRINITE (TELOCOLLINITE): 0.67 % (MEAN OF 100 MAXIMUM
STANDARD DEVIATION: 0.054 % READINGS UNDER OIL)

ASH: 38.1% TOTAL SULFUR: 3.91% (DRY BASIS)
ANALYST: JJM, DATE OF ANALYSIS: 04-19-85, PROJECT: IBSCP
DESCRIPTION: SCLEROTINITE=0.2% (AS MEASURED); OTHER LIPTINITE=FLUORINITE

ISGS

Table 4. *(Continued)*

SAMPLE NO. IBCSP-5 SEAM: HERRIN (NO.6) LAB. NO. C25189
LOCATION: SOUTHWESTERN ILLINOIS SAMPLE COLLECTED BY RDH, 12-03-85
SAMPLE TYPE: CHANNEL OF SEAM;IMPURITIES >3/8" PRESENT IN SAMPLE
NOTE: 3-TON CHANNEL EXCLUSIVE OF 6"@ TOP & BOTTOM; N-SEALED BY ARGONNE NAT.L.

DATA SET: C25189.

MACERAL/MINERAL	VOLUME PERCENT MEASURED	MINERAL CORRECTED	MINERAL FREE
TOTAL VITRINITE	81.8	76.5	86.7
EXINITE	2.4	2.2	2.5
RESINITE	0.8	0.7	0.8
OTHER LIPTINITE	nil	nil	nil
TOTAL LIPTINITE	3.2	3.0	3.4
MICRINITE	1.0	0.9	1.1
MACRINITE/SCLEROTINITE	1.2	1.1	1.3
SEMIFUSINITE	3.6	3.4	3.8
FUSINITE	2.8	2.6	3.0
INERTODETRINITE	0.8	0.7	0.8
TOTAL INERTINITE	9.4	8.8	10.0
PYRITE	1.8	1.8	
OTHER MINERALS	3.8	9.9	
CALCITE OBSERVED (Y OR N)	Y		
OTHER SULFIDES OBSERVED (Y OR N)	N		

TOTAL COUNT: 500

REFLECTANCE, VITRINITE (TELOCOLLINITE): 0.50 % (MEAN OF 100 MAXIMUM
STANDARD DEVIATION: 0.034 % READINGS UNDER OIL)

ASH: 17.8% TOTAL SULFUR: 4.27% (DRY BASIS)
ANALYST: JJM, DATE OF ANALYSIS: 08-13-86, PROJECT: IBCSP
DESCRIPTION: MACRINITE = 0.6%, SCLEROTINITE = 0.6% (AS MEASURED)
ISGS

Table 5. Pyrite characterization and pyrite cleanability index

SAMPLE NO. IBCSP-1 SEAM: HERRIN (NO. 6) LAB NO: C22542.P
LOCATION: WEST CENTRAL ILLINOIS ANALYSIS DATE: 04/18/86
SAMPLE TYPE: RUN OF PREPARATION PLANT PARTICLE SIZE: -20 MESH

RESULTS FOR PYRITIC GRAINS

PARTICLE TYPE *	NO. OF GRAINS	MEAN DIAMETER (μM)	% DIAMETER	% DIAMETER (V,I,T BASIS)
VITRITE	225	5.00	38.36	56.25
INERTITE	0	-	-	-
TRIMACERITE	175	5.00	29.83	43.75
CARBOMINERITE	48	8.94	14.63	
PYRITIC COAL	23	13.83	10.85	
FREE PYRITE	29	6.40	6.33	
TOTAL	500	5.87	100.0	

PYRITE CLEANABILITY INDEX: 0.47

SAMPLE NO. IBCSP-2 SEAM: COLCHESTER (NO. 2) LAB NO: C22543.P
LOCATION: WESTERN ILLINOIS ANALYSIS DATE: 04/21/86
SAMPLE TYPE: RUN OF PREPARATION PLANT PARTICLE SIZE: -20 MESH

RESULTS FOR PYRITIC GRAINS

PARTICLE TYPE *	NO. OF GRAINS	MEAN DIAMETER (μM)	% DIAMETER	% DIAMETER (V,I,T BASIS)
VITRITE	197	4.50	34.77	54.18
INERTITE	1	2.41	0.09	0.14
TRIMACERITE	160	4.67	29.31	45.68
CARBOMINERITE	97	6.46	24.58	
PYRITIC COAL	17	11.34	17.56	
FREE PYRITE	28	3.36	3.69	
TOTAL	500	5.10	100.0	

PYRITE CLEANABILITY INDEX: 0.56

*THE COMPOSITION OF PYRITE BEARING PARTICLES ARE DISTINQUISHED AS FOLLOWS:
VITRITE = >95% VITRINITE; INERTITE = >95% INERTINITE;
TRIMACERITE = >95% OF 2 OR 3 DIFFERENT GROUP MACERALS;
CARBOMINERITE = 5-20% PYRITE OR 20-60% CLAY, QUARTZ, AND CALCITE;
PYRITIC COAL = 20-95% PYRITE; FREE PYRITE = >95% PYRITE (LIBERATED).
NOTE: TRACES OF PYRITE IN LIPTITE (IF ANY) IS ADDED TO VITRITE.
ISGS

% Σ Diameter is the sum of the diameter of all pyrite grains measured in the indicated particle type, expressed as a percentage of all grains measured. Theoretically, this measure is proportional to the weight percent of pyrite in the given particle type. See footnote *, page 17, for definitions of particle types.

Table 5. *(Continued)*

SAMPLE NO. IBCSP-3 SEAM: SEE NOTE LAB NO: C22544.P
LOCATION: SOUTHERN ILLINOIS ANALYSIS DATE: 04/22/86
SAMPLE TYPE: RUN OF PREPARATION PLANT PARTICLE SIZE: -20 MESH

NOTE: 80% SPRINGFIELD (NO.5) AND 20% HERRIN (NO.6) SEAMS

RESULTS FOR PYRITIC GRAINS

PARTICLE TYPE *	NO. OF GRAINS	MEAN DIAMETER (μM)	% DIAMETER	% DIAMETER (V,I,T BASIS)
VITRITE	222	4.15	42.99	53.67
INERTITE	0	-	-	-
TRIMACERITE	193	4.12	37.10	46.33
CARBOMINERITE	71	4.99	16.53	
PYRITIC COAL	1	4.82	0.22	
FREE PYRITE	13	5.19	3.16	
TOTAL	500	4.28	100.0	

PYRITE CLEANABILITY INDEX: 0.25

SAMPLE NO. IBCSP-4 SEAM: HERRIN (NO. 6) LAB NO: C22545.JJM
LOCATION: SOUTHWESTERN ILLINOIS ANALYSIS DATE: 04/22/86
SAMPLE TYPE: RUN OF MINE PARTICLE SIZE: -20 MESH

RESULTS FOR PYRITIC GRAINS

PARTICLE TYPE *	NO. OF GRAINS	MEAN DIAMETER (μM)	% DIAMETER	% DIAMETER (V,I,T BASIS)
VITRITE	86	5.86	8.25	26.32
INERTITE	4	4.82	0.32	1.01
TRIMACERITE	193	7.21	22.77	72.67
CARBOMINERITE	167	9.77	26.71	
PYRITIC COAL	39	25.40	16.22	
FREE PYRITE	211	7.45	25.73	
TOTAL	700	8.72	100.0	

PYRITE CLEANABILITY INDEX: 2.19

SAMPLE NO. IBCSP-5 SEAM: HERRIN (NO.6) LAB NO: C25189.D
LOCATION: SOUTHWESTERN ILLINOIS ANALYSIS DATE: 8-15-86
SAMPLE TYPE: CHANNEL PARTICLE SIZE: -20 MESH
NOTE: 3-TON CHANNEL EXCLUSIVE OF 6 " @ TOP & BOTTOM; N - SEALED AT MINE
BY ARGONNE NATIONAL LABORATORY

RESULTS FOR PYRITE GRAINS

PARTICLE TYPE *	NO. OF GRAINS	MEAN DIAMETER (μM)	% DIAMETER	% DIAMETER (V,I,T BASIS)
VITRITE	123	4.25	13.96	55.33
INERTITE	1	14.46	0.39	1.55
TRIMACERITE	91	4.48	10.88	43.12
CARBOMINERITE	17	8.65	3.93	
PYRITIC COAL	63	17.98	30.24	
FREE PYRITE	205	7.42	40.60	
TOTAL	500	7.49	100.0	

PYRITE CLEANABILITY INDEX: 2.96

Table 6. Mineral analyses of coal samples

SAMPLE NO. IBCSP-1 SEAM: HERRIN (NO.6) LAB. NO. C22542
LOCATION: WEST CENTRAL ILLINOIS COLLECTED BY MDS 6-15-83
SAMPLE TYPE: RUN OF PREPARATION PLANT

RESULTS (WEIGHT % BY LOW TEMP. ASHING)

ORGANIC MATTER: 87.0

MINERAL MATTER: 13.0

MINERAL COMPOSITION (% OF SAMPLE BY X-RAY DIFFRACTION)

QUARTZ	: 2.6		
CALCITE	: 0.5		
PYRITE (BY CHEMISTRY)	: 2.1	PYRITE (BY X-RAY DIFF.)	: 1.7
CLAY (BY DIFFERENCE)	: 7.8		

VARIETIES OF CLAY MINERALS (% OF SAMPLE)

KAOLINITE	: 3.3
ILLITE	: 2.4
EXPANDABLE	: 2.1

OTHER MINERALS DETECTED: MINOR - MARCASITE
TRACE - ANHYDRITE & SZOMOLNOKITE

ANALYST: DJL, DATE OF ANALYSIS: 04-15-86, PROJECT: IBCSP

SAMPLE NO. IBCSP-2 SEAM: COLCHESTER (NO.2) LAB. NO. C22543
LOCATION: WESTERN ILLINOIS COLLECTED BY MDS, 7-10-83
SAMPLE TYPE: RUN OF PREPARATION PLANT

RESULTS (WEIGHT % BY LOW TEMP. ASHING)

ORGANIC MATTER: 90.0

MINERAL MATTER: 10.0

MINERAL COMPOSITION (% OF SAMPLE BY X-RAY DIFFRACTION)

QUARTZ	: 0.6		
CALCITE	: 2.7		
PYRITE (BY CHEMISTRY)	: 4.0	PYRITE (BY X-RAY DIFF.)	: 2.7
CLAY (BY DIFFERENCE)	: 2.7		

VARIETIES OF CLAY MINERALS (% OF SAMPLE)

KAOLINITE	: 1.0
ILLITE	: 0.8
EXPANDABLE	: 0.9

OTHER MINERALS DETECTED: MINOR - MARCASITE & COQUIMBITE

ANALYST: DJL, DATE OF ANALYSIS: 04-15-86, PROJECT: IBCSP

Table 6. *(Continued)*

SAMPLE NO. IBSCP-3 SEAM: SEE NOTE LAB. NO. C22544
LOCATION: SOUTHERN REGION OF ILLINOIS COLLECTED BY MDS 11-08-83
SAMPLE TYPE: RUN OF PREPARATION PLANT

NOTE: 80% SPRINGFIELD (NO.5) AND 20% HERRIN (NO.6) SEAMS

RESULTS (WEIGHT % BY LOW TEMP. ASHING)

ORGANIC MATTER: 90.2

MINERAL MATTER: 9.8

- -

MINERAL COMPOSITION (% OF SAMPLE BY X-RAY DIFFRACTION)

QUARTZ : 1.4

CALCITE : NIL

PYRITE : 1.8 (BY CHEMISTRY) PYRITE : 1.4 (BY X-RAY DIFF.)

CLAY : 6.6 (BY DIFFERENCE)

VARIETIES OF CLAY MINERALS (% OF SAMPLE)

KAOLINITE : 2.6
ILLITE : 2.7
EXPANDABLE : 1.3

OTHER MINERALS DETECTED: MINOR - MARCASITE
TRACE - SZOMOLNOKITE

ANALYST: DJL, DATE OF ANALYSIS: 04-15-86, PROJECT: IBSCP

SAMPLE NO. IBCSP-4 SEAM: HERRIN (NO.6) LAB. NO. C22545
LOCATION: SOUTHWESTERN ILLINOIS COLLECTED BY JMB, 12-15-83
SAMPLE TYPE: RUN OF MINE

RESULTS (WEIGHT % BY LOW TEMP. ASHING)

ORGANIC MATTER: 57.0

MINERAL MATTER: 43.0

- -

MINERAL COMPOSITION (% OF SAMPLE BY X-RAY DIFFRACTION)

QUARTZ : 8.0

CALCITE : 1.6

PYRITE : 4.6 (BY CHEMISTRY) PYRITE : 3.1 (BY X-RAY DIFF.)

CLAY : 28.8 (BY DIFFERENCE)

VARIETIES OF CLAY MINERALS (% OF SAMPLE)

KAOLINITE : 6.4
ILLITE : 9.9
EXPANDABLE : 12.5

OTHER MINERALS DETECTED: MINOR - SZOMOLNOKITE
TRACE - PLAGIOCLASE

ANALYST: DJL, DATE OF ANALYSIS: 04-15-86, PROJECT: IBSCP

Table 6. *(Continued)*

SAMPLE NO. IBCSP-5 SEAM: HERRIN (NO.6) LAB. NO. C25189
LOCATION: SOUTHWESTERN ILLINOIS COLLECTED BY RDH 12-03-83
SAMPLE TYPE: CHANNEL OF SEAM; IMPURITIES >3/8 " PRESENT IN THE SEAM

NOTE: 3-TON CHANNEL EXCLUSIVE OF 6" AT TOP & BOTTOM; N-SEALED BY ARGONNE NATIONAL LABORATORY

RESULTS (WEIGHT % BY LOW TEMP. ASHING)

ORGANIC MATTER: 79.1

MINERAL MATTER: 20.9

- -

MINERAL COMPOSITION (% OF SAMPLE BY X-RAY DIFFRACTION)

QUARTZ	: 4.0		
CALCITE	: 2.7		
PYRITE (BY CHEMISTRY)	: 4.2	PYRITE (BY X-RAY DIFF.)	: 3.0
CLAY (BY DIFFERENCE)	: 10.0		

VARIETIES OF CLAY MINERALS (% OF SAMPLE)

KAOLINITE	: 4.1
ILLITE	: 2.5
EXPANDABLE	: 3.4

OTHER MINERALS DETECTED: MINOR - MARCASITE
TRACE - DOLOMITE

ANALYST: DJL, DATE OF ANALYSIS: 07-30-86, PROJECT: IBSCP

Appendix. Investigators of samples from the Illinois Basin Coal Sample Program

ALBAL, RAJ ISGS, CHAMPAIGN, IL 61820

SAMPLE #	DATE(MM/DD/YR)
01180800	71984

PROJECT TITLE:

LOW TEMPERATURE CHARRING.
CONTACT: M. STEPHENSON OR D. RAPP AT ISGS, CHAMPAIGN, IL

ATHERTON, LINDA EPRI, 3412 HILLVIEW AVE, PALO ALTO, CA 94303

SAMPLE #	DATE(MM/DD/YR)	
01181200	082885	SAMPLE FORWARDED TO BARRY WILSON, BATTELLE, RICHAND, WA

PROJECT TITLE:

MICROBIALLY INDUCED SPONTANEOUS COMBUSTION

ATWOOD, J CHEMISTRY, UNIV. ALABAMA, UNIVERSITY, AL 35486

SAMPLE #	DATE(MM/DD/YR)	
02160407	082885	
03160407	082885	
04030613	082885	ONE 1 LB BAG

PROJECT TITLE:

LIQUEFACTION UNDER AMBIENT CONDITIONS

BRADEN, H. POLYBAC CORP., 954 MARCON BLVD, ALLENTOWN, PA 18103

SAMPLE #	DATE(MM/DD/YR)	
01	102284	1 LB BAG
02	102284	1 LB BAG
03	102284	1 LB BAG
04	102284	1 LB BAG

PROJECT TITLE:

DESULFURIZATION WITH BACTERIA.

NOTE: ILLINOIS COAL WAS NEVER USED. THEY USED SOME PENNSYLVANIA COAL ACQUIRED THROUGH PENN. STATE UNIV.
CONTACT: C. S. MCDOWELL, POLYBAC CORP. AT THE ABOVE ADDRESS.

BRUCHNER, A. UNIVERSAL OIL PROD., 10 UOP PLAZA, DES PLAINES, IL 60016

SAMPLE #	DATE(MM/DD/YR)	
01180700	032284	
03160600	032284	
04030300	032884	ONE 20 LB BAG

PROJECT TITLE:

BRUCHNER HAS MOVED FROM UOP; NO ONE ELSE NAMED.

BUCHANAN, D. H. CHEMISTRY DEPT, EASTERN IL UNIV., CHARLESTON, IL 61920

SAMPLE #	DATE(MM/DD/YR)
02160415	061785
04030604	061785

PROJECT TITLE:

CHEMICAL CHARACTERIZATION OF ILLINOIS COAL

RESULTS: LOW TEMPERATURE AIR OXIDATION OF COALS IN THE IBSCP RENDER THEM LESS SOLUBLE IN PYRIDINE, THF AND OTHER SOLVENTS. THE PYRIDINE SOLUBLE, TOLUENE INSOLUBLE FRACTIONS (TIPS) BECOME PARTIALLY INSOLUBLE UPON OXIDATION. CHANGES IN FT-IR SPECTRA, SOLVENT SWELLING, GPC TRACES OF SOLUBLE FRACTIONS, PHENOL OH CONTENT AND ELEMENTAL ANALYSES ARE CONSISTENT WITH THE VIEW THAT THE PYRIDINE SOLUBLE FRACTION OF THESE COALS IS A PHENOL RICH MATERIAL WHICH IS HYDROGEN BONDED TO THE INSOLUBLE COAL RESIDUE AND WITHIN ITSELF.

CHAVEN, C. ISGS, 615 E. PEABODY DR., CHAMPAIGN, IL 61820.

SAMPLE #	DATE(MM/DD/YR)
02160516	030585
02160513	030585

PROJECT TITLE:

ELEMENTAL S, SO4; TRANSFORMATION OF PYRITE TO S & SO4; CL, BR, F, P

OBJECTIVES: ATTEMPT WILL BE MADE TO DEVISE A NEW SULFUR FRACTIONATION PROCEDURE FOR COAL AND ITS PYROLYTIC PRODUCTS - NAMELY CHAR, AND POSSIBLY OTHER TREATMENTS SUCH AS EXPLOSIVE SHATTERING TECHNIQUE, SUPER CRITICAL EXTRACTION ETC.

CHOU, J. ISGS, 615 E. PEABODY DR., CHAMPAIGN, IL 61820

SAMPLE #	DATE(MM/DD/YR)
01120416	040286 ONE 1- BAG
02160916	040286 ONE 1- BAG
03141516	040286 ONE 1- BAG
04051316	040286 ONE 1- BAG

PROJECT TITLE:

EFFICIENCY OF SULFUR REMOVAL BY MICROBIAL DESULFURIZATION.

CHUNG, DR. K. E. SCIENCE CTR, ROCKWELL INT'L CORP., THOUSAND OAKS, CA 91360

SAMPLE #	DATE(MM/DD/YR)
01120305	052586 A 20 LB BAG
01120306	052586 A 20 LB BAG

PROJECT TITLE:

NOT YET AVAILABLE

CLARKSON, R. UNIV. OF ILL., NOYES LAB, URBANA, IL 61801

SAMPLE #	DATE(MM/DD/YR)
01180101	092383 URBANA, IL
02160201	092383
03160101	092383

PROJECT TITLE:

EPR & ENDOR STUDIES OF RADICALS IN COAL AND COAL LITHOTYPES

COLEMAN, D. ISGS, CHAMPAIGN, IL 61820

SAMPLE #	DATE(MM/DD/YR)
01180405	061784
02160514	050885
03160402	050885
04030610	050885

PROJECT TITLE:

BEHAVIOR OF SULFUR DURING DESULFURZATION.

DEBARR, J. ISGS, 615 E. PEABODY DR., CHAMPAIGN, IL 61820

SAMPLE #	DATE(MM/DD/YR)
01180413	071685
03160409	071685

PROJECT TITLE:

CHAR DESULFURIZATION & COAL DEAGGLOMERATION USING THERMAL GRAVIMETRIC AND MICRO-DILATOMETER ANALYSES

OBJECTIVES: DETERMINATION OF DEVOLATIZATION AND SWELLING CHARACTERISTICS USING TGA AND TMA EQUIPMENT, AND THE REACTIVITY OF CHARS PRODUCED FROM THESE SAMPLES.

DEBRUNNER, P. G. UNIV. OF ILL, 331 LOOMIS LAB, URBANA, IL 61801

SAMPLE #	DATE(MM/DD/YR)
01180104	092383
01181406	010786
02160204	092383
03160104	092383

PROJECT TITLE:

THE DESULFURIZATION OF ILLINOIS COAL BY IN-SITU PREPARATION OF IRON CATALYSTS.

RESULTS: (1) THE ASTM ASSAY FOR PYRITE IS NOT RELIABLE. (2) PYRITE OXIDATION TO SOME FORM OF IRON OXIDE IS A SERIOUS PROBLEM IN COALS THAT ARE NOT STORED UNDER STRICTLY ANAEROBIC CONDITIONS. (3) IN THE SAMPLES OF THE ILLINOIS COAL BANK, SPECIFICALLY THE FRACTION OF IRON OXIDES INCREASES SUBSTANTIALLY AT THE EXPENSE OF PYRITE OVER THE LAST TWO YEARS.

DUGAN, P. OHIO STATE UNIV., 484 W. 12TH AVE., COLUMBUS, OH 43210

SAMPLE #	DATE(MM/DD/YR)
02160307	010786
03160307	010786

PROJECT TITLE:

ENERGY DISPERSIVE X-RAY FOR PYRITE AND METALS

DUTY, R. CHEMISTRY DEPT, ILL. STATE UNIV., NORMAL, IL 61761

SAMPLE #	DATE(MM/DD/YR)
03160107	092385
03160108	092385
03160109	092385

PROJECT TITLE:

ORG. S. REACTIONS, CARBOXYLATION & PROTICAPROTIC SOLVENTS

EHRLINGER, HANK ISGS, CHAMPAIGN, IL 61820

SAMPLE #	DATE(MM/DD/YR)	
01181600	062383	
01181500	062383	
01180900	071784	USED BY MIKE BUCKENTIN FOR STEM WORK
01171600	062383	
01171500	062383	
02151515	070683	
02151600	070683	
02161500	070683	
02161616	070683	
03151400	072683	
03151500	072683	
03151600	072683	
03161400	072683	
03161500	072683	
03161600	072683	
04030606	070683	2-1 LB BAGS 6,7
04050300	070683	1-20 LB BAG
04050102	072683	14-1 LB BAGS 2-15
04050102	072683	12-1 LB BAGS 2-7,10-12,14-16
04010200	072683	2-20 LB BAGS 2,3
04010102	072683	11-1 LB BAGS 2,3,4,7,8,9,10,13,14,15,16
04030102	072683	11-1 LB BAGS 2,3,4,7,8,9,10,13,14,15,16
04030606	072683	1-1 LB BAG

PROJECT TITLE:

FINE COAL CLEANING BY AGGREGATE FLOTATION

OBJECTIVES: DEVELOP AND OPTIMIZE THE ISGS AGGREGATE FLOTATION PROCESS FOR CLEANING SULFUR AND ASH FROM FINELY CRUSHED COAL.

FROST, J. K. ISGS, 615 E. PEABODY DR., CHAMPAIGN, IL 61820

SAMPLE #	DATE(MM/DD/YR)
01180407	061784
01180408	061784
04030605	061784 1-1 LB BAG

PROJECT TITLE:

SECONDARY REFERENCE STANDARDS FOR THE ANALYTICAL CHEMISTRY SECTION.

OBJECTIVE: COAL BANK SAMPLES #1 AND #4 HAVE BEEN ADOPTED FOR USE AS SECONDARY REFERENCE SAMPLES. THEY WILL BE REPEATEDLY ANALYSED OVER A LONG PERIOD OF TIME FOR MAJOR, MINOR AND TRACE ELEMENTS.

GIDASPOW, D. CHEM. ENG. DEPT., RM. 105PH, IIT CENTER, CHICAGO, IL 60616

SAMPLE #	DATE(MM/DD/YR)
04081000	031886
04081500	031886

PROJECT TITLE:

DESULFURIZATION OF ILLINOIS COAL IN AN ELECTROFLUIDIZED BED.

RESULTS: AN EXPERIMENT WAS DONE WITH ILLINOIS #2 COAL OF 75 MICRON AVERAGE PARTICLE SIZE HAVING 5.2% PYRITES. WITH 12000 VOLTS IN AN ELECTROFLUIDISED BED THEY WERE ABLE TO REDUCE PYRITES TO 3.33% IN THE FIRST RUN.

GOECKNER, N. A. WESTERN IL UNIV., CURRENTS HALL 438A, MACOMB, IL 61455

SAMPLE #	DATE(MM/DD/YR)
01180411	010985
02160508	010985

PROJECT TITLE:

THE CATALYTIC CONVERSION OF ILLINOIS COAL TO LIQUID PRODUCTS.

GRAFF, R. CHEM. ENG. DEPT., CITY COLLEGE, NEW YORK, NY 10031

SAMPLE #	DATE(MM/DD/YR)
01180301	092184
01180311	092184
01180313	092184
01180314	092184
03160308	092184
03160311	092184
03160313	092184

PROJECT TITLE:

STEAM PRETREATMENT OF COAL.

HACKLEY, K. ISGS, 615 E. PEABODY DR., CHAMPAIGN, IL 61820

SAMPLE #	DATE(MM/DD/YR)	
01180402	120385	
01180403	120385	
01180404	120385	
01180410	120385	
01180416	120385	
03160401	120385	
03160403	030885	
03160412	030885	

PROJECT TITLE:

BEHAVIOR OF SULFUR DURING DESULFURIZATION (ISOTOPE)

HAGY, JOHN DRAINSWERKE INC.,801 SWEET GUM RD.,PITTSBURGH,PA 15243

SAMPLE #	DATE(MM/DD/YR)	
04030700		1-20 LB BAG

PROJECT TITLE:

STIRRED BALL MILL GRINDING TESTS
NOTE: THEY MANUFACTURE MACHINES USED TO GRIND COAL.

HOWELL, WAYNE CHEMICAL ENG. DEPT., 125 RAL, UNIV. OF ILL. URBANA 61801

SAMPLE #	DATE(MM/DD/YR)	
03141100	031186	1-20LB BAG

PROJECT TITLE:

STUDY OF ATTRITION IN FLUIDIZED BED PYROLYSIS

HUGHES, R. ISGS, 615 E. PEABODY DR., CHAMPAIGN, IL 61820

SAMPLE #	DATE(MM/DD/YR)	
01180305	042584	
02160504	042584	
03160314	042584	
04070109	042584	1-1 LB BAG

PROJECT TITLE:

CARBON MONOXIDE/ETHANOL DESULFURIZATION.

OBJECTIVE: IDENTIFY THE AFFECTS OF MINERAL IMPURITES ON THE DESULFURIZATION PROCESS.

IGNASIAK, DR. B. INTERIM HIGH PRESSURE FAC., 1901 5TH ST., NISKU, ALB., CANADA

SAMPLE #	DATE(MM/DD/YR)	
01120600	052086	A 20 LB BAG
01120500	052086	A 20 LB BAG

PROJECT TITLE:

NOT YET AVAILABLE

JEPSON, W. P. UNIV. OF ILL., 207 ROGER ADAMS LAB., URBANA, IL 61801

SAMPLE #	DATE(MM/DD/YR)
03161000	030585

PROJECT TITLE:

SPRAYING OF COAL/OIL AND COAL/WATER SLIMES

JERGER, D. IGT, 3424 S. STATE ST., CHICAGO, IL 60616

SAMPLE #	DATE(MM/DD/YR)
01180107	092383
01180108	092383
01180109	092383

PROJECT TITLE:

DESULFURIZATION OF COAL IN ELECTROFLUIDIZED BED.
CONTACT: DR. D. GIDASPOW: CHEM. ENG., IIT CENTER, CHICAGO, IL 60616

JOHNSON, W. UNIV. OF VICTORIA, VICTORIA, BC (CANADA)

SAMPLE #	DATE(MM/DD/YR)
01180316	092184
02160509	050885
03160315	092084

KRIER, H. UNIV. OF ILL., 214 MECH. ENG. BLDG., URBANA, IL 61801

SAMPLE #	DATE(MM/DD/YR)	
01140900	110185	8-20LB. BAGS 09-16 (200 LBS)
03130000	092185	400 LBS.

PROJECT TITLE:

STUDIES OF SO2 REMOVAL DURING PULVERIZED COAL COMBUSTION BY INJECTING LIMESTONE.
OBJECTIVE: DETERMINE OPTIMUM MIXTURE RATIOS, MIXTING TIMES, PARTICLE SIZES AND TEMPERATURE FOR THE CAPTURE OF SULFUR OXIDES THROUGH LIMESTONE INJECTION.

KWANG, E. C. ROCKWELL INT. CORP. 1049 BOX 1085, THOUSAND OAKS, CA 91360

SAMPLE #	DATE(MM/DD/YR)
01181401	100285

PROJECT TITLE: CHEMICAL-STRUCTURAL CHARACTER. USING NAOH/ETHANOL/H2O REACTIONS
NOTE: CONTACT DR. K. CHUNG AT ROCKWELL.

MILLER, K. ISGS, 615 E. PEABODY DR., CHAMPAIGN, IL 61820

SAMPLE #	DATE(MM/DD/YR)
04031301	010786 10 LB. SAMPLE, 1-8 BAGS.

PROJECT TITLE:

MICROBIAL DESULFURIZATION OF COAL.

MIRZA, IGBAL ISGS, 615 E. PEABODY DR., CHAMPAIGN, IL 61820

SAMPLE #	DATE(MM/DD/YR)
01181300	062685

PROJECT TITLE:

FLUIDIZED BED PYROLYSIS & CHAR DESULFURIZATION

MUCHMORE, C. SOUTHERN IL UNIV., CHEM. ENG., CARBONDALE, IL 62901

SAMPLE #	DATE(MM/DD/YR)
01130000	041885 400 LBS.
01170100	081283 14-20 LB. BAGS 01-14
02150300	081283 12-20 LB. BAGS 03-14
03150200	072683 12-20 LB. BAGS 02-13

PROJECT TITLE:

SUPERCRITICAL EXTRACTION OF SULFUR

NARAYAN, D. R. PURDUE UNIV., POTTER BLDG, WEST LAFAYETTE, IN 47907

SAMPLE #	DATE(MM/DD/YR)
01180308	111484
01120800	052086 A 20 LB BAG

PROJECT TITLE:

COAL STRUCTURE AND REACTIVITY USING K-CROWN ETHER REAGENT

GIONY, L. 144 MECH ENG., UNIVERSITY OF ILLINOIS, URBANA, IL 61801

SAMPLE #	DATE(MM/DD/YR)
02161300	052586 A 20 LB BAG

PROJECT TITLE:

DESULFURIZATION USING STEAM AT 700 DEG. C.

SERIO, MICHAEL A. ADV. FUEL RESEARCH, 87 CHURCH, EAST HARTFORD, CT 06108

SAMPLE #	DATE(MM/DD/YR)
01180409	050885
01180414	050885
02160507	050885
02160510	050885
04030612	050885 2-1 LB BAGS 12, 14

PROJECT TITLE:

CHEMICAL AND PHYSICAL DEVELOPMENT OF CHAR PARTICLES DURING DEVOLATILIZATION.

OBJECTIVE: WILL PROVIDE ACCURATE PREDICTIONS FOR THE THERMAL, OPTICAL, PHYSICAL, AND REACTIVE PROPERTIES OF CHARS AS THEY DEVELOP DURING DEVOLATILIZATION UNDER CONDITIONS TYPICAL OF GASIFIER OPERATION.

SMITH, CARL J. WV GEOLOGICAL SURVEY, PO BOX 879, MORGANTOWN, WV 26507

SAMPLE #	DATE(MM/DD/YR)
01000000	081586
02000000	081586
04000000	081586

PROJECT TITLE:

ASH FUSION STUDY OF WEST VA

TO DEVELOP EQUATIONS TO PREDICT ASH FUSION TEMPERTURE FROM OTHER KNOWNS; E.G., ASH/TOTAL SULFUR/PYRITIC SULFUR. WE WANT TO LOOK AT COAL FROM INTERIOR BASIN VS OUR MODEL.

SOO, S. L. UNIV. OF ILL., 123 MECH. ENG. BLDG, URBANA, IL 61801

SAMPLE #	DATE(MM/DD/YR)
01180200	092383
01181000	071784
02150100	072783
02160100	072783
02160600	071784
03160200	092383
01120800	011285

PROJECT TITLE:

STEAM ENHANCED OXIDATIVE DESULFURIZATION

RESULTS: AN EXPERIMENT PERFORMED WITH HERRIN NO. 6 COAL, ACHIEVED SULFUR REMOVAL UP TO 65% OF TOTAL SULFUR IN HERRIN NO. 6 COAL.

RAPP, DAVID ISGS, 615 E. PEABODY DR., CHAMPAIGN, IL 61820

SAMPLE #	DATE(MM/DD/YR)	
04031600	010786	20-LB SAMPLE
04030500	010786	20-LB SAMPLE
04031309	010786	10-LB SAMPLE, BAGS 9-16

PROJECT TITLE:

AGGREGATE FLOTATION AND FINE COAL CLEANING PROCESS.

OBJECTIVE: DEVELOP AND OPTIMIZE THE ISGS AGGREGATE FLOTATION PROCESS.

RAUCHFUSS, T. UNIV. OF ILL., 335 NOYES LAB., URBANA, IL 61801

SAMPLE #	DATE(MM/DD/YR)
01180102	092383
02160202	092383
03160102	092383
03160410	030885

PROJECT TITLE:

MOLECULAR MODELS FOR DESULF. CATALYSIS

REUTHER, JAMES J. BATTELLE, 505 KING AVE., COLUMBUS, OH 43201-2693

SAMPLE #	DATE(MM/DD/YR)	
01140100	061785	8-20 LB. BAGS 01-08

PROJECT TITLE:

EVALUATION OF CALCIUM IMPREGNATED COAL AS A FUEL FOR TURBINE COMBUSTORS SULFUR CAPTURE BY RAW COALS AND CA-IMPREGNATED COALS FROM ILL. #6 IS INDEPENDENT OF SULFUR FORM, IE, ORGANIC VS. INORGANIC SULFUR.

SCHARFF, M. F. SCI. APPL'TN INT'L, 10401 ROSELLE, SAN DIEGO, CA 92121

SAMPLE #	DATE(MM/DD/YR)	
03160408	082585	
04030615	082585	1-1 LB BAG

PROJECT TITLE:

REDUCTION OF PHOSPO-GYPSUM FROM FLA. PHOSPHATES TO PRODUCE CONCENTRATED SULFUR.

RESULTS: COAL PROVIDES HEAT AND REDUCTANT GASES TO CONVERT CASO4 TO A SULFUR PRODUCT. RESULTS ARE COMPLETED FOR COALS FROM OHIO, E. KY, AND IBCSP #3. ALL COALS GAVE CONVERSION TIMES WELL LESS THAN 1 MINUTE, BUT THE ILLINOIS COAL SAMPLE WAS THE BEST.

STEPHENSON, M. ISGS, 615 E. PEABODY DR., CHAMPAIGN, IL 61820

SAMPLE #	DATE(MM/DD/YR)	
01180303	110883	6-4LB. BAGS 3,4,6,7,9,10
01180401	110883	4-4 LB. BAGS 1,6,11,15
01120100	012086	
02160700	110883	
03160300	110883	
03160404	110883	7-4 LB. BAGS 4-6,11,14-16
03160900	072084	
03160800	012086	

PROJECT TITLE:

LOW TEMPERATURE CHARRING.

RESULTS: HIGH SULFUR COAL SAMPLES WERE PYROLIZED TO REDUCE THE SULFUR CONTENT FROM ABOUT 4% TO 2.8% AND THEN TREATED WITH HYDROGEN TO REDUCE THE SULFUR CONTENT TO 1% OR LESS.

STOCK, L. M. DEPT. OF CHEMISTRY,UNIV. OF CHICAGO,CHICAGO, IL 60637

SAMPLE #	DATE(MM/DD/YR)	
01180105	092383	4 LB. BAGS 5,6
02160205	092383	4 LB. BAGS 5,6
03160105	092383	4 LB. BAGS 5,6

PROJECT TITLE:

THE NATURE AND CHEMISTRY OF THE SULFUR COMPOUNDS IN ILLINOIS COAL. ELEMENTAL SULFUR, PRESENT IN WEATHERED SAMPLES OF THE ILLINOIS COALS, IS ABSENT IN THE SINGLE PRISTINE SAMPLE NOW AVAILABLE. OXIDIZED ORGANIC SULFUR COMPOUNDS ARE ALSO PRESENT IN THE WEATHERED COALS. NEITHER ALIPHATIC THIOLS NOR AROMATIC THIOLS APPEAR TO BE PRESENT IN THE ILLINOIS COALS. HENCE, WE POSTULATE THAT THE PRINCIPAL SULFUR-CONTAINING ORGANIC CONSTITUENTS ARE APPORTIONED AMONG DIARYL SULFIDES, ARYL ALKYL SULFIDES, AND HETEROCYCLIC COMPOUNDS. IN AN EARLIER STUDY, WE ESTABLISHED THAT THE SULFUR COMPOUNDS THAT ARE PRESENT IN ILLINOIS COALS ENHANCE THEIR LIQUEFACTION REACTIONS SIGNIFICANTLY. DESULFURIZATION REACTIONS USING REDUCTIVE, ANION-RADICAL CHAIN REACTIONS AND CATION-RADICAL PROCESSES ARE ALSO UNDER INVESTIGATION.

TWO QUITE DIFFERENT REACTION SYSTEMS HAVE BEEN FOUND FOR THE CLEAVAGE OF CARBON-SULFUR BONDS.

STOICOS, T. UNIVERSAL OIL PRODUCTS, PLAINES, IL

SAMPLE #	DATE(MM/DD/YR)	
04070200		29 LB BAG

PROJECT TITLE:

NOT KNOWN.
STOICOS IS NO LONGER WITH UNIVERSAL OIL PRODUCTS; NO CONTACT AVAILABLE.

UPADHYA, K. BOX 4348, CHEM. ENG.,UNIV. OF ILL.,CHICAGO, IL 60680

SAMPLE #	DATE(MM/DD/YR)
01120401	040286 15 1-LB BAGS 01-15
02160901	040286 15 1-LB BAGS 01-15
03141501	040286 15 1-LB BAGS 01-15
04081301	040286 15 1-LB BAGS 01-15

PROJECT TITLE:

MECHANISMS AFFECTING SULFUR REMOVAL FROM COAL IN H2 OR H2O+H2 ENVIRONMENT.

WERT, C. UNIV. OF ILL., 217 MET. DEPT. URBANA, IL 61801

SAMPLE #	DATE(MM/DD/YR)
01180103	092383
02160203	092383
03160103	092383

PROJECT TITLE:

MICROCHEMISTRY OF COAL AND ORGANIC S BY SCAN TRANS ELECTRON MICROSCOPY.

WHAM, ROBERT OAK RIDGE NAT.LAB, BLDG 4501,MS 217, OAK RIDGE TN 37831

SAMPLE #	DATE(MM/DD/YR)
01120306	052086
01120308	052086
01120711	052086

PROJECT TITLE:

NOT YET AVAILABLE

YOUNG, JOHN E. ARGONNE NAT'L LAB.,9700 CASS,BLDG 205,ARGONNE,IL 60439

SAMPLE #	DATE(MM/DD/YR)
?SAMPLE	#