INFORMATION SERIES 10

COLORADO COAL ANALYSES 1976 - 1979

Edited by Nirbhao S. Khalsa
and L. R. Ladwig

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COLORADO GEOLOGICAL SURVEY
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PART I

INTRODUCTION

Colorado ranks fourth in the U.S. in coal resources, having estimated in-place coal reserves in excess of 434 billion tons to a depth of 6,000 feet or less and with nearly 129 billion tons of identified coal resource to a depth of 3,000 feet. In addition, Colorado ranks first in low sulfur bituminous coal resource (Murray, 1979). These resources place Colorado in a position of importance for meeting the energy demands of the future.

Since 1975, the Colorado Geological Survey, in cooperation with the U.S. Geological Survey, has had an on-going project to evaluate the chemical composition of Colorado coals. This project entails sampling of active and inactive mines and cores from drilling projects throughout the state. The samples are treated in a methodical manner to ensure consistency of results. Proximate, ultimate, and heat-of-combustion analyses are included for all samples. In most cases, trace element analyses are included; in some cases, petrographic analyses. Where available, stratigraphic information is included to aid in estimating, evaluating, and classifying Colorado coals. Table 5 provides a quick reference to the samples including location, cross reference to sample and laboratory numbers, sample type, formation, bed, age, and the page reference for more detailed information.

Unlike many eastern coal beds, western coal beds are generally laterally discontinuous. However, in some cases, western coal beds do occur in continuous zones. For this reason, this report uses the coal zone names on stratigraphic columns.

To provide sample analysis information for each coal region in the state, the sections on the North Park Region and the Grand Mesa field are reprinted from U.S. Geological Survey open-file report 79-1099 and 80-980 respectively. Sample analyses from the Grizzly Creek Strip, Marr No. 1 Strip, and Canadian Strip mines (North Park Region) were also published by the Colorado Geological Survey in Colorado Coal Analyses, 1975 (Boreck and others, 1977), along with sample analyses from three other regions. A summary of some of Cameron Engineers drill-core analyses from the Denver Region have also been added to this report (other CGS publications are available with Colorado coal sample analysis data).

Figure 1 shows the coal-bearing regions in the State and the approximate sample locations. The Colorado stratigraphic correlation chart (see Figure 2) has been shaded to indicate the coal bearing formations which are all of Cretaceous age or younger.

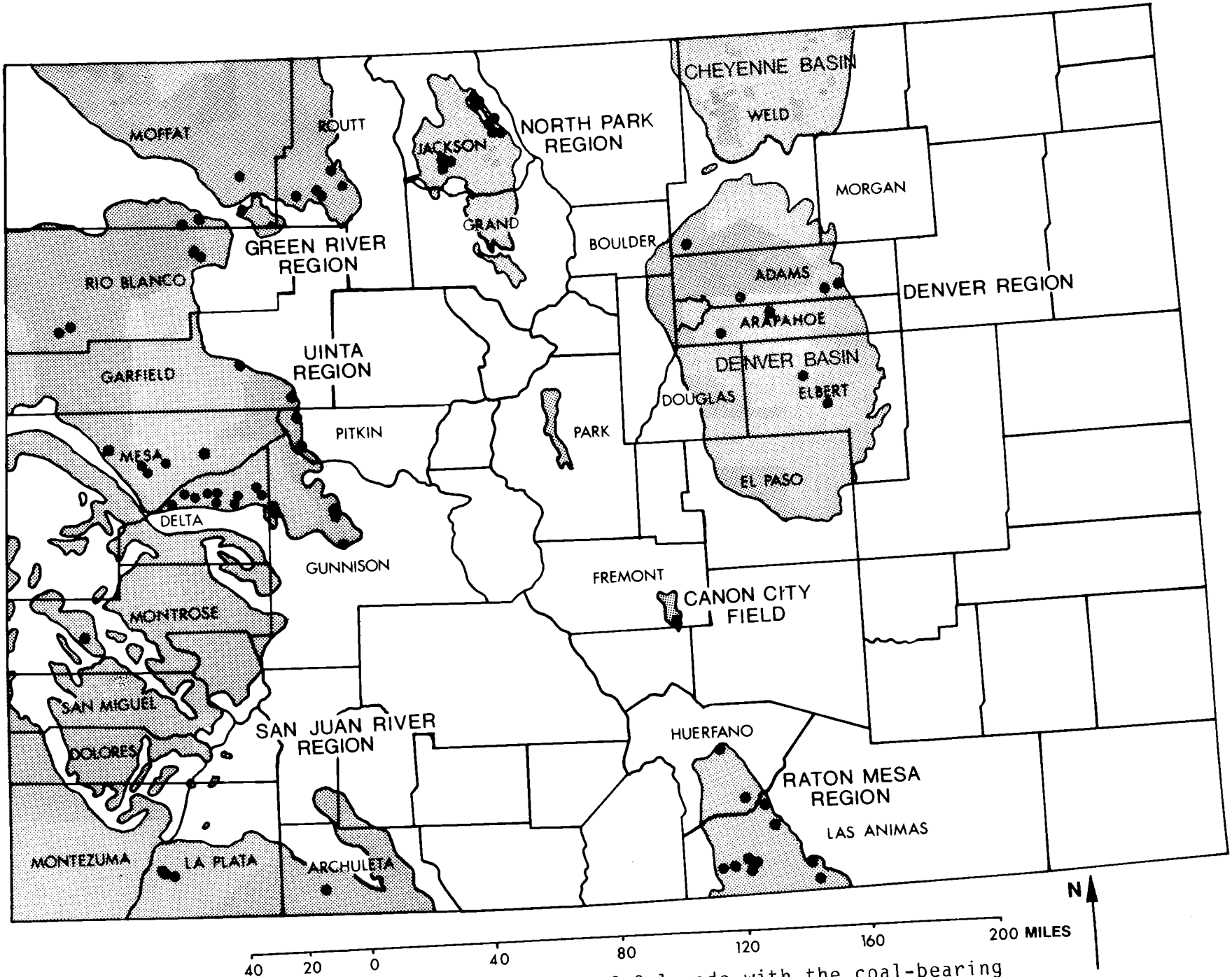


Figure 1. Map of the State of Colorado with the coal-bearing regions shown in gray. Approximate coal-sample locations are designated by black dots.

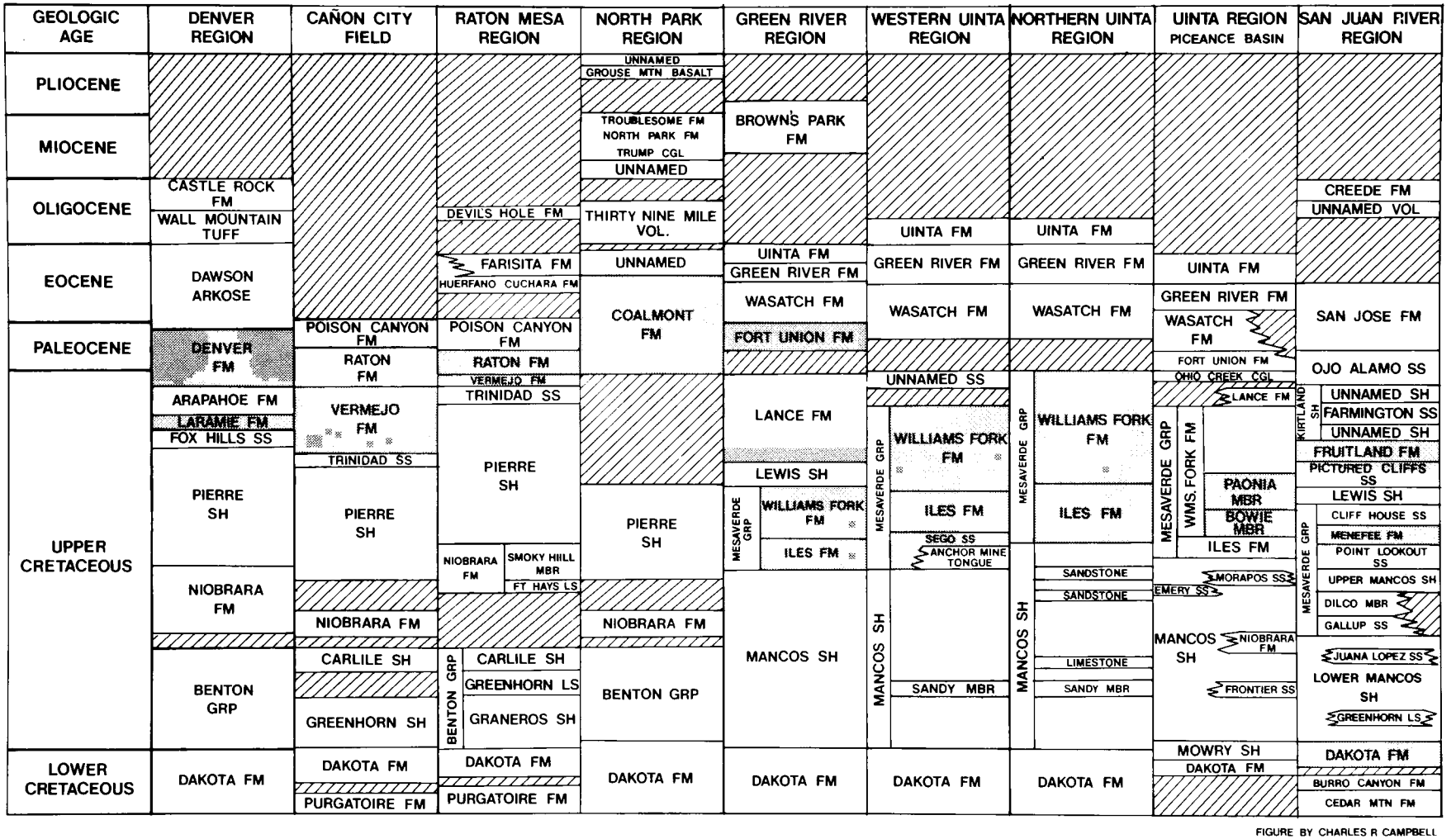


Figure 2. Stratigraphic correlation chart for the Lower Cretaceous through Pliocene. Gray shading indicates coal-bearing formations or zones (after Collins, 1976; Fisher and others, 1960; Henkes, 1959; Landis, 1959; Pearl and Murray, 1974).

SAMPLE DISTRIBUTION

This report includes analyses of coal samples from most of the major coal regions and fields in the State (see table 1 and figure 1). The coal region and field terminology used in this report are the same as that on CGS Map Series 12 (Goolsby and others, 1978). There are a total of 295 samples from 100 locations, broken down as follows: 270 are coal samples, 25 are rock samples, 114 samples are from coal mines, and 181 are from drill cores.

TABLE 1 - Number of samples and locations from mines and cores for each region

	SAMPLE TYPE				TOTAL	
	MINE		CORE HOLE			
Region	No. of Sample Locations	No. of Samples	No. of Sample Locations	No. of Samples	No. of Sample Locations	No. of Samples
Denver	1	3	8	18	9	21
Green River	2	11	6	20	8	31
North Park	3	18	10	26	13	44
Raton Mesa	4	16	11	29	15	45
Canon City field	2	6	0	0	2	6
San Juan River	3	10	2	2	5	12
Uinta	25	50	23	86	48	136
TOTALS	40	114	60	181	100	295

In three cases, coal analyses were given to the CGS for use and publication. Since these samples were analyzed by commercial laboratories and do not include trace element analyses, they are tabulated separately from other sample analyses at the end of their representative sections. The coal analyses include 11 core samples from the Denver Region (compliments of Cameron Engineers), 10 core samples from the Uinta Region, Danforth Hills field (compliments of the Colowyo Coal Company); and 5 core sample analyses from the Green River Region, Yampa field (compliments of Hayden Gulch Coal Company).

The sampled locations have been plotted on figure 1, Colorado Coal Regions, and also on regional maps at the front of each section in Part II. It should be noted that the geographic and stratigraphic distribution of the samples included in this report is biased in favor of accessible existing mines that are often contiguous to each other. For valid statistical studies, a better sample distribution from mines, core holes, etc., is necessary (Swanson, 1976).

SAMPLE COLLECTION PROCEDURES AND DESCRIPTION

In order to assure consistent results, a uniform procedure for handling both field and laboratory samples was followed as closely as conditions permitted.

Sampling conditions and bed weathering affect the quality of a sample and care was taken to minimize their effect. If the coal face is not fresh, a fresh face is prepared before a sample is taken. The surface is brushed to remove miscellaneous rock fragments. Channel samples are collected along the prepared zone perpendicular to the bed, each sample weighing about 5 pounds. The samples are then sealed in plastic bags to retain moisture and retard oxidation.

The approach to description is systemmatic, both in terms used and format. Detailed lithologic descriptions and measurements are included where available. The rock units overlying and underlying the coal bed are referred to respectively as roof rock and floor rock. When sampled, they are bagged separately from the coal samples. Brief descriptions of these rock units are included where available.

Coal descriptions include identification of major and minor components (macerals), partings, secondary mineralization including the more important minerals, and joint (cleat) orientation. Most coal is banded due to the interlayering of two or more ingredients of coal such as vitrain, fusain and attrital coal (attritus). The shiny black bands are vitrain. Previtrain occurrs in lignite as dense woody lenses. It is the equivalent of vitrain in bituminous coal. Fusain resembles charcoal and appears in dull black lenses or masses. Attrital coal is the microfragmental matrix that occupies the interstices between other coal ingredients or macerals. The attritus can range from bright to dull in luster, although it is never as bright as vitrain (Schopf, 1960). Shaly or impure coal has a high ash content (25 to 60 percent). Partings are bands of shale, volcanic ash, sandstone, or other sedimentary rock which are interbedded with the coal. Secondary mineralization in the coal is also described in the samples. The more important minerals, kaolinite, calcite, gypsum, resin, and pyrite are identified and included in sample descriptions where observed. Systems of vertical jointing, called cleat, often occur in coal beds. The major (most prominent) system is called the face cleat; the minor system, roughly perpendicular to the face cleat, is called the butt cleat. Secondary mineralization frequently occurs along the cleat face. The orientation of these planar systems is measured and included in this report whenever possible.

COAL ANALYSES AND PHYSICAL TESTS

The analyses for this report were done partly by the U.S. Bureau of Mines and the U.S. Department of Energy, in Pittsburgh, Pennsylvania, and partly by the U.S. Geological Survey in Denver, Colorado. A flow chart of the different analyses is shown in figure 3 and summarized in table 2.

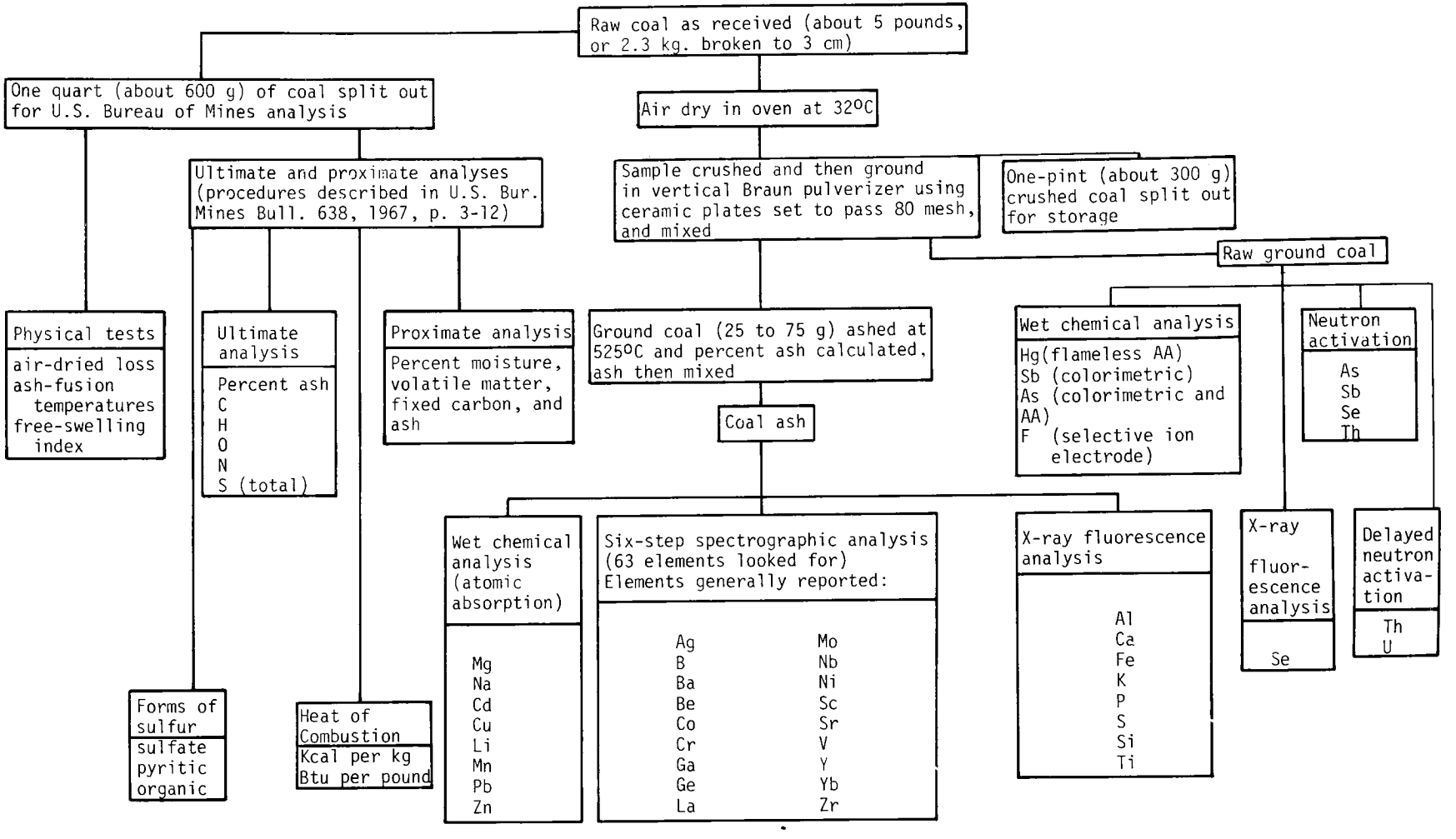


Figure 3. Flow chart showing sequence of sample preparation and chemical analysis. (Modified from Swanson and Huffman, 1976, Fig. 1).

Table 2. Analyses and physical tests performed by the various laboratories.

U.S. Department of Energy

Proximate analysis (percent)
- Moisture
- Volatile matter
- Fixed carbon
- Ash

Ultimate analysis (percent)
- Hydrogen (H)
- Carbon (C)
- Nitrogen (N)
- Oxygen (O)
- Sulfur (S)
- Ash

Heat of combustion (Btu/pound; Kcal/g)

Forms of sulfur (percent)
- Sulfate
- Pyritic
- Organic

Fusibility of ash (Temp. °C)
- Initial deformation
- Softening temperature
- Fluid temperature

Free-swelling index

U.S. Geological Survey

Major and minor elements (percent)[1]
- Silicon (Si)
- Aluminum (Al)
- Calcium (Ca)
- Magnesium (Mg)
- Sodium (Na)
- Potassium (K)
- Iron (Fe)
- Titanium (Ti)
- Phosphorous (P)
- Sulfur (S)

Trace elements (ppm)[2]
- Arsenic (As)
- Beryllium (Be)
- Boron (B)
- Barium (Ba)
- Cadmium (Cd)
- Cerium (Ce)
- Cobalt (Co)
- Chromium (Cr)
- Copper (Cu)
- Fluorine (F)
- Gallium (Ga)
- Germanium (Ge)
- Mercury (Hg)
- Lanthanum (La)
- Lithium (Li)
- Manganese (Mn)
- Molybdenum (Mo)
- Niobium (Nb)
- Neodymium (Nd)
- Nickel (Ni)
- Lead (Pb)
- Antimony (Sb)
- Scandium (Sc)
- Selenium (Se)
- Silver (Ag)
- Strontium (Sr)
- Thorium (Th)
- Uranium (U)
- Vanadium (V)
- Yttrium (Y)
- Ytterbium (Yb)
- Zinc (Zn)
- Zirconium (Zr)

[1]Reported as oxides in 525°C laboratory ash as well as on a whole-coal basis.
[2]Reported as ppm on a whole-coal basis and/or in 525°C laboratory ash.

The U.S. Bureau of Mines (now the U.S. Department of Energy) performed the proximate and ultimate analyses, and determined heat-of-combustion (Btu/lb), ash-fusibility temperature, forms of sulfur, and free-swelling indices. Information regarding the analytical methods can be found in Methods of Analyzing and Testing Coal and Coke, Office of the Director of Coal Research, U.S. Bureau of Mines, 1967.

The U.S. Geological Survey has determined trace-element, major-, and minor-oxide compositions of whole coal and laboratory ash samples. The data are fundamental in determining the economic value of the coal, in evaluating environmental effects of coal mining and of coal use, and in determining potential byproduct recovery and the adaptability of the coal beneficiation, gasification, liquefaction, and other technologic processes of coal treatment. Other uses relate to coal-bed correlations, depositional environments of peat accumulation and alteration of the coal (Swanson and Huffman, 1976).

Several different analytical methods were used to determine the different elements. These methods include atomic absorption, six- step spectrographic, and x-ray fluorescence techniques on both coal and ash plus neutron activation, delayed neutron activation, colorimetric, and selective ion electrode techniques on the whole coal. (See the flow chart in figure 3).

COAL RANK

Apparent rank for all coal samples in this report was calculated (see table 3) according to ASTM standards.

Coals with less than 69 percent fixed carbon on a dry, mineral-matter-free basis (DMMF) are classified according to caloric value (Btu/lb) on the moist, mineral-matter-free basis (MMMF). However, coals with more than 14,000 Btu/lb (MMMF) and more than 69 percent fixed carbon (DMMF) are classified according to percent fixed carbon (DMMF) (American Society for Testing Materials, 1978).

Coal rank, bed thickness, and depth of burial are the characteristics used to classify coal reserves (Landis, 1959, p. 132).

COAL PETROGRAPHY

The petrographic study of coal can be used to accurately predict certain properties of coal samples. It has been successfully applied by the coking coal industry to decrease the need for empirical tests. Other important uses of this analysis are as follows:

1. Determination of coal carbonization product yields.
2. Prediction of free-swelling indices and Btu values.
3. Determination of coal oxidation tendencies.

Table 3. Classification of coals by rank. (Classification of coals by rank, American Society of Testing and Materials, 1978, D-388-77).

Class	Group	Fixed Carbon Limits, percent (Dry, Mineral-Matter-Free Basis)		Volatile Matter Limits, percent (Dry, Mineral-Matter-Free Basis)		Calorific Value Limits, Btu per pound (Moist,[b] Mineral-Matter-Free Basis)		Agglomerating Character
		Equal or Greater Than	Less Than	Greater Than	Equal or Less Than	Equal or Greater Than	Less Than	
I. Anthracitic	1. Meta-anthracite	98	...	...	2	...	...	nonagglomerating
	2. Anthracite	92	98	2	8	...	...	
	3. Semianthracite[c]	86	92	8	14	...	...	
II. Bituminous	1. Low volatile bituminous coal	78	86	14	22	...	...	commonly agglomerating[e]
	2. Medium volatile bituminous coal	69	78	22	31	...	...	
	3. High volatile *A* bituminous coal	...	69	31	...	14 000[d]	...	
	4. High volatile *B* bituminous coal	...	...	...	...	13 000[d]	14 000	
	5. High volatile *C* bituminous coal	...	...	...	...	11 500	13 000	
						10 500	11 500	agglomerating
III. Subbituminous	1. Subbituminous *A* coal	...	...	...	...	10 500	11 500	nonagglomerating
	2. Subbituminous *B* coal	...	...	...	...	9 500	10 500	
	3. Subbituminous *C* coal	...	...	...	...	8 300	9 500	
IV. Lignitic	1. Lignite *A*	...	...	...	...	6 300	8 300	
	2. Lignite *B*	...	...	...	...	...	6 300	

[a] This classification does not include a few coals, principally nonbanded varieties, which have unusual physical and chemical properties and which come within the limits of fixed carbon or calorific value of the high-volatile bituminous and subbituminous ranks. All of these coals either contain less than 48 percent dry, mineral-matter-free fixed carbon or have more than 15,500 moist, mineral-matter-free British thermal units per pound.

[b] Moist refers to coal containing its natural inherent moisture but not including visible water on the surface of the coal.

[c] If agglomerating, classify in low-volatile group of the bituminous class.

[d] Coals having 69 percent or more fixed carbon on the dry, mineral-matter-free basis shall be classified according to fixed carbon, regardless of calorific value.

[e] It is recognized that there may be nonagglomerating varieties in these groups of the bituminous class, and there are notable exceptions in high volatile *C* bituminous group.

Table 4. Petrographic Coal Data

SUMMARY OF SAMPLE IDENTIFICATION

CGS Sample #	Type of Sample	Coalfield	County	Mine Name	Coal Seam Name	Coal Seam Thickness	U.S.G.S. ID
77-DJ-5	Bench Channel	Grand Hogback	Garfield	Eastside	E	4.8'	196214
77-DJ-6	Bench Channel				E	4.8'	196215
77-DJ-8	Bench Channel				E	4.7'	196216
77-DJ-12	Face Channel	Grand Hogback	Garfield	NuGap 3	Sunnyridge	5.75'	196218
76-DJ-7	Tipple	Carbondale	Garfield	Sunlight	A, C, D	--	184636
77-DJ-19	Bench Channel	Carbondale	Pitkin	Coal Basin	Coal Basin B	2.8'	196221
77-DJ-18	Bench Channel					5.5'	196222
77-DJ-21	Face Channel	Carbondale	Pitkin	L.S. Wood	Coal Basin B		196223
76-DJ-19	Bench	Carbondale	Pitkin	Dutch Creek #1	B	3.2'	184637
76-DJ-20	Bench	Carbondale	Pitkin			3.2'	184638
77-DJ-15	Bench	Carbondale	Pitkin	Dutch Creek #2	Dutch Creek	2.4'	196219
77-DJ-20	Bench					2.75'	196220
76-DB-3	Bench	Somerset	Gunnison	Hawks Nest #3	E	2.5	184652
76-DB-5	Bench					3.0'	184653
76-DB-6	Bench					3.0'	184654
76-DB-1	Bench	Somerset	Gunnison	Bear	C	3.0'	184650
76-DB-2	Bench					3.0'	184651
76-DJ-15 thru 17	Channel	Somerset	Gunnison		B	6.3'	

RESULTS OF MACERAL ANALYSES

CGS Sample #	% of Total Seam	Vitrinite	Pseudo-Vitrinite	Semi-Fusinite	Fusinite	Macrinite	Micrinite	Exinite	Resinite	Mean Max Reflectance
77-DJ-21	33.6	65.1	17.5	8.9	3.9	0.4	0.8	2.6	0.8	0.776
76-DJ-19	33.6	66.4	18.3	7.3	3.2	0.2	1.1	3.1	0.4	0.834
76-DJ-20	32.9	66.6	18.3	5.6	2.9	0.4	0.9	4.5	0.8	0.774
Combined	100.08	66.09	18.05	7.28	3.34	0.33	0.94	3.39	0.66	0.796
77-DJ-15	100.0	61.0	22.1	7.5	3.7	0.4	0.9	3.8	0.6	0.756
77-DJ-20	100.0	68.2	14.7	5.1	4.9	0.3	1.5	4.4	0.9	0.764
Combined	33.7	72.8	14.7	8.7	2.0	0.7	0.9	0.2	0	1.257
76-DB-3	66.3	61.3	20.2	11.4	4.7	0.2	1.1	0.2	0.9	1.263
76-DB-5	100.02	65.17	18.34	10.49	3.79	0.39	1.03	0.21	0.6	1.261
Combined	100.0	69.6	15.6	10.3	2.8	0.1	0.7	0.3	0.6	1.350
76-DB-6	50.0	73.0	12.2	9.6	3.8	0.1	1.1	0	0.2	1.365
76-DB-1	50.0	68.7	19.8	8.1	2.6	0.1	0.5	0	0.2	1.371
76-DB-2	100.0	70.85	16.0	8.85	3.2	0.1	0.8	0	0.2	1.368
Combined	46.6	62.1	29.5	6.0	2.1	0	0.3	0	0	1.120
77-DJ-5	53.4	67.8	20.5	7.1	3.0	0.2	1.2	0.2	0	1.150
77-DJ-6	100.02	65.15	24.70	6.59	2.58	0.11	0.78	0.11	0	1.140
77-DJ-8	45.5	62.6	25.2	3.8	2.0	0	2.4	3.7	0.3	0.778
Combined	54.5	66.8	20.7	5.3	2.1	0.1	2.1	2.8	0.1	0.763
77-DJ-12	99.99	64.89	22.75	4.62	2.05	0.05	2.23	3.21	0.19	0.770
76-DJ-7	100.0	71.8	17.6	6.3	3.6	0.3	0.4	0	0	1.381
77-DJ-19	50.0	63.5	13.2	14.8	2.7	0.3	0.7	4.5	0.3	0.736
77-DJ-18	50.0	72.6	12.9	5.7	1.8	0.4	1.6	4.9	0.1	0.742
Combined	100.0	68.05	13.05	10.25	2.25	0.35	1.15	4.7	0.2	0.739
76-DJ-15 thru 17	100.0	70.3	10.6	7.4	4.1	0.4	2.2	3.0	0.4	0.815

4. Categorization of coal for certain combustion uses.

5. Guiding coal preparation practices.

6. Aiding in solving combustion and boiler problems.

7. Prediction of coke air pressures.

(Goolsby and others, 1979).

Coal petrography can also be used to study coal conversion processes, coal bed correlations, tectonic problems, petroleum maturation, paleogeography, stratigraphy, paleoecology, origin of coals, methane generation in coals, and in coal exploration (Goolsby and others, 1979). The petrographic analyses of some of these samples are included in table 4.

EXPLANATION OF STATISTICAL TERMS USED IN SUMMARY TABLES
(From Hatch, Madden and Affolter, 1979)

In these reports the geometric mean (GM) is used as the estimate of the most probable concentration (mode); the geometric mean is calculated by taking the logarithm of each analytical value, summing the logarithms, dividing the sum by the total number of values, and obtaining the antilogarithm of the result. The measure of scatter about the mode used here is the geometric deviation (GD), which is the antilog of the standard deviation of the logarithms of the analytical values. These statistics are used because the quantities of trace elements in natural materials commonly exhibit positively skewed frequency distributions; such distributions are normalized by analyzing and summarizing trace-element data on a logarithmic basis.

If the frequency distributions are lognormal, the geometric mean is the best estimate of the mode, and the estimated range of the central two-thirds of the observed distribution has a lower limit equal to GM/GD and an upper limit equal to GM·GD. The estimated range of the central 95 percent of the observed distribution has a lower limit equal to GM/GD^2 and an upper limit equal to $GM \cdot GD^2$ (Conner and others, 1976).

Although the geometric mean is, in general, an adequate estimate of the most common analytical value, it is, nevertheless, a biased estimate of the arithmetic mean. The estimate of the arithmetic means listed in the summary tables are Sichel's $\underline{t}$ statistic (Miesch, 1967).

A common problem in statistical summaries of trace-element data arises when the element content of one or more of the samples is below the limit of analytical detection. This situation results in a "censored" distribution. Procedures developed by Cohen (1959) were used to compute unbiased estimates of the geometric mean, geometric deviation, and arithmetic mean when the data are censored.

APPLICATION OF THIS REPORT

This report is designed to provide not only coal sample analyses, but also other information about the coal regions and individual sample locations. Due to the size of this report, a few comments regarding its basic organization may be helpful.

Part I of this report contains introductory information relevant to coal sampling and analysis. Table 5 is a complete list of all samples, locations, etc., as well as the page number referring to the individual sample data sheet in Part II. Figures 4, 5 and 6 compare the arithmetic mean and range of analytical results for the six different regions. Part II is composed of seven sections covering each of the six major coal regions of the state with one special report on the Grand Mesa field within the Uinta Region. Each section has a sample index, a region map showing sample locations, a stratigraphic section, sample data sheets (except sections C and G), and tabulated chemical analyses. The sample data sheets include extra stratigraphic and general geologic information such as overburden thickness, bed thickness, thickness and section sampled, lithology, sample numbers, etc. They are arranged alphabetically by field.

The analytical tables at the end of each section include proximate and ultimate, heat-of-combustion, forms of sulfur, free-swelling index, ash deformation temperature, major- and minor-oxide, and trace element composition analyses. The summary tables include arithmetic and geometric means, observed range, and geometric deviation for each of the above listed analyses for the entire region. In some cases only proximate and ultimate analyses were obtained. These results are tabulated at the very end of each section.

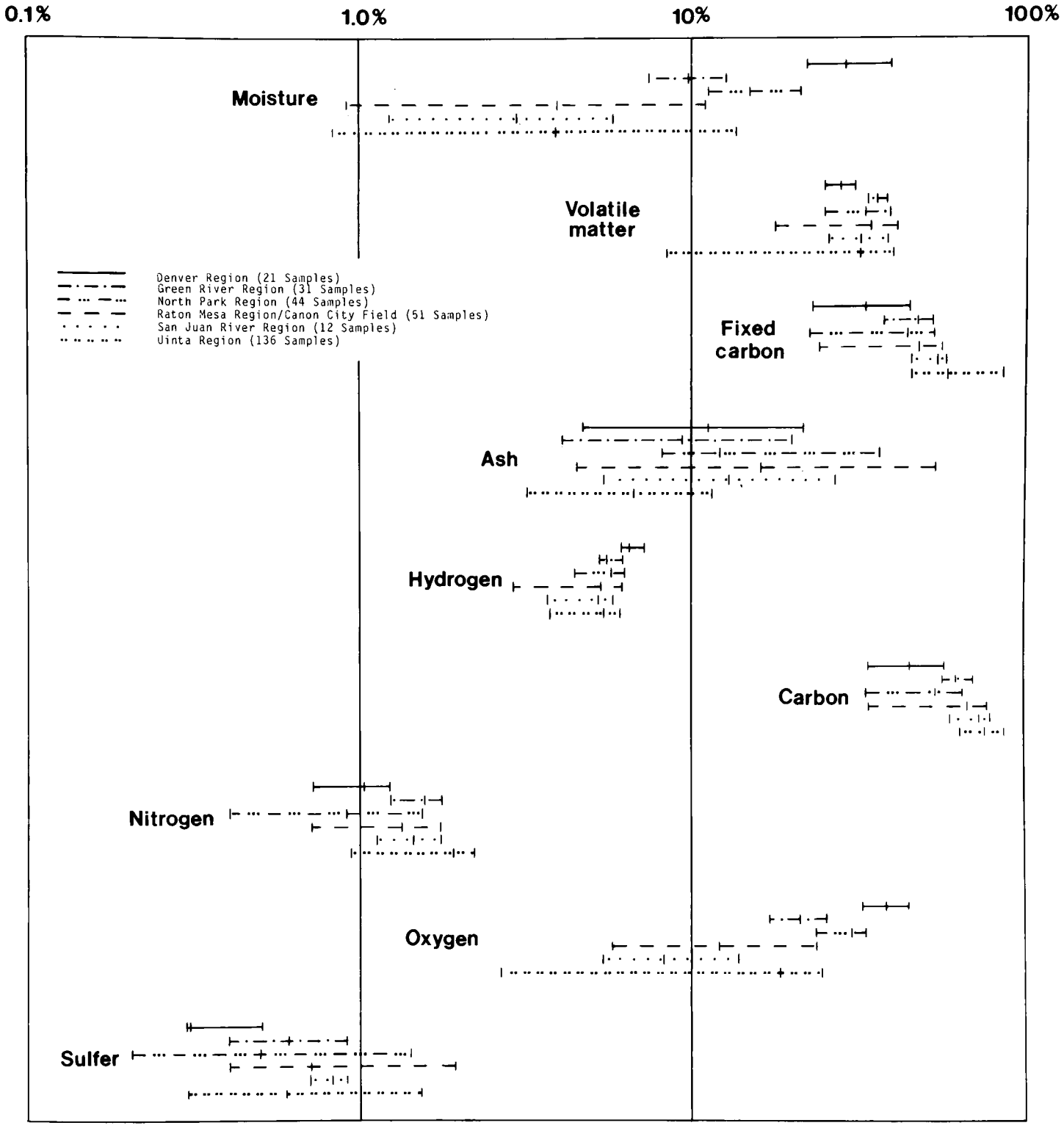


Figure 4. Arithmetic means and ranges for the proximate analyses and ultimate analyses for coal samples from the Denver, Green River, North Park, Raton Mesa (plus Canon City field), San Juan River, and Uinta Regions.

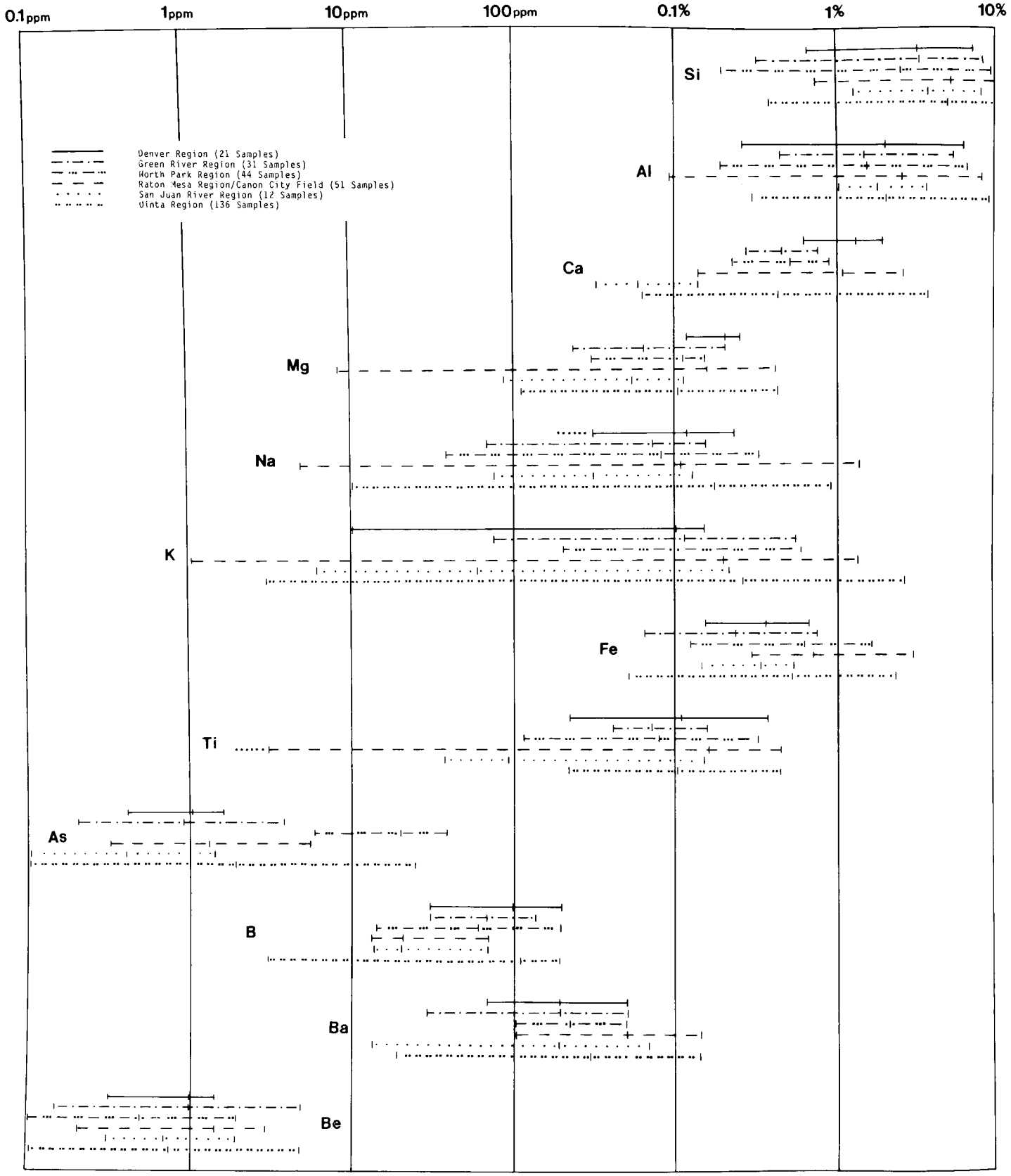
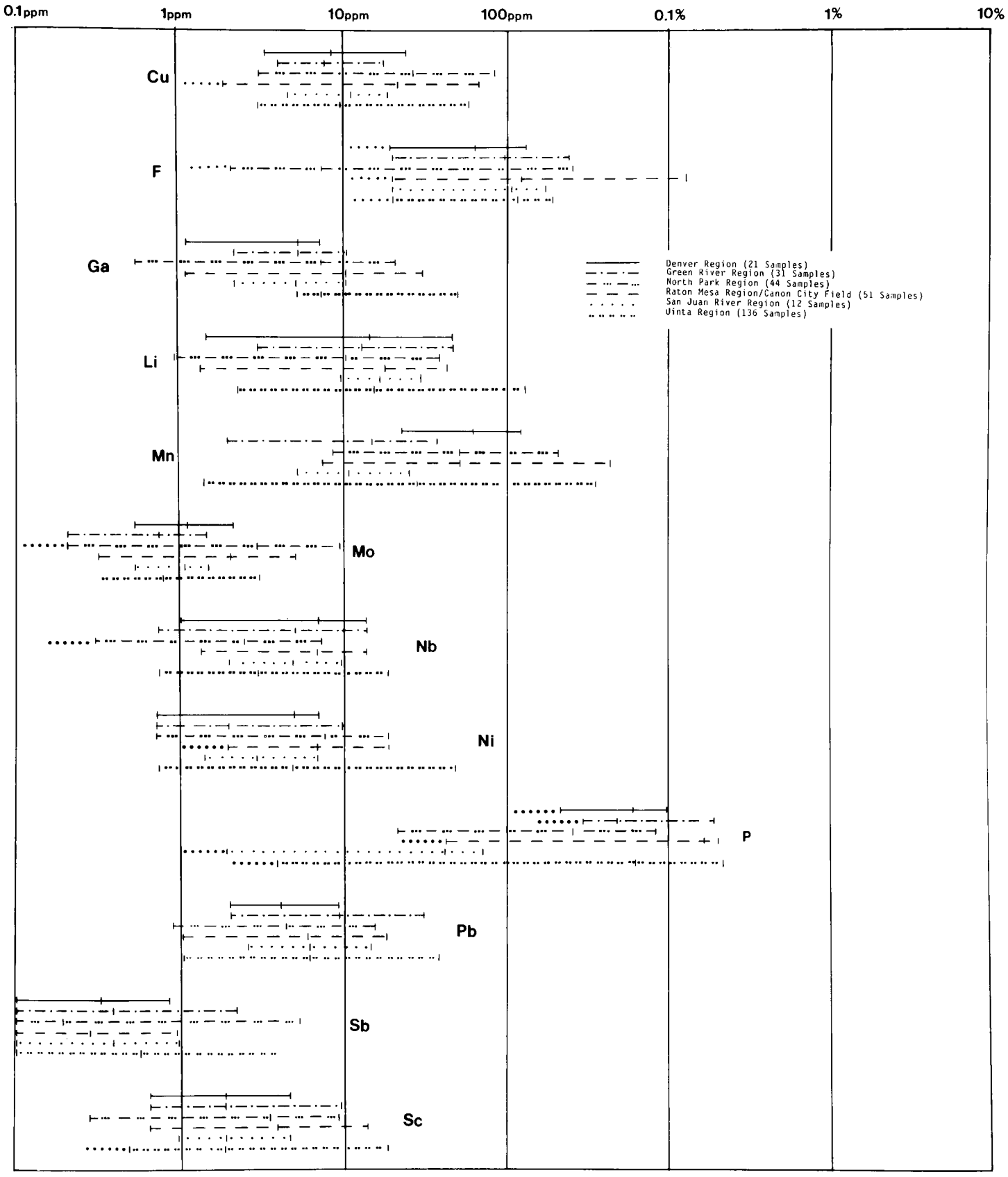


Figure 5. Arithmetic means and ranges for the contents of 33 elements (whole-coal basis) in coal samples from the Denver, Green River, North Park, Raton Mesa (plus Canon City field), San Juan River, and Uinta Regions.



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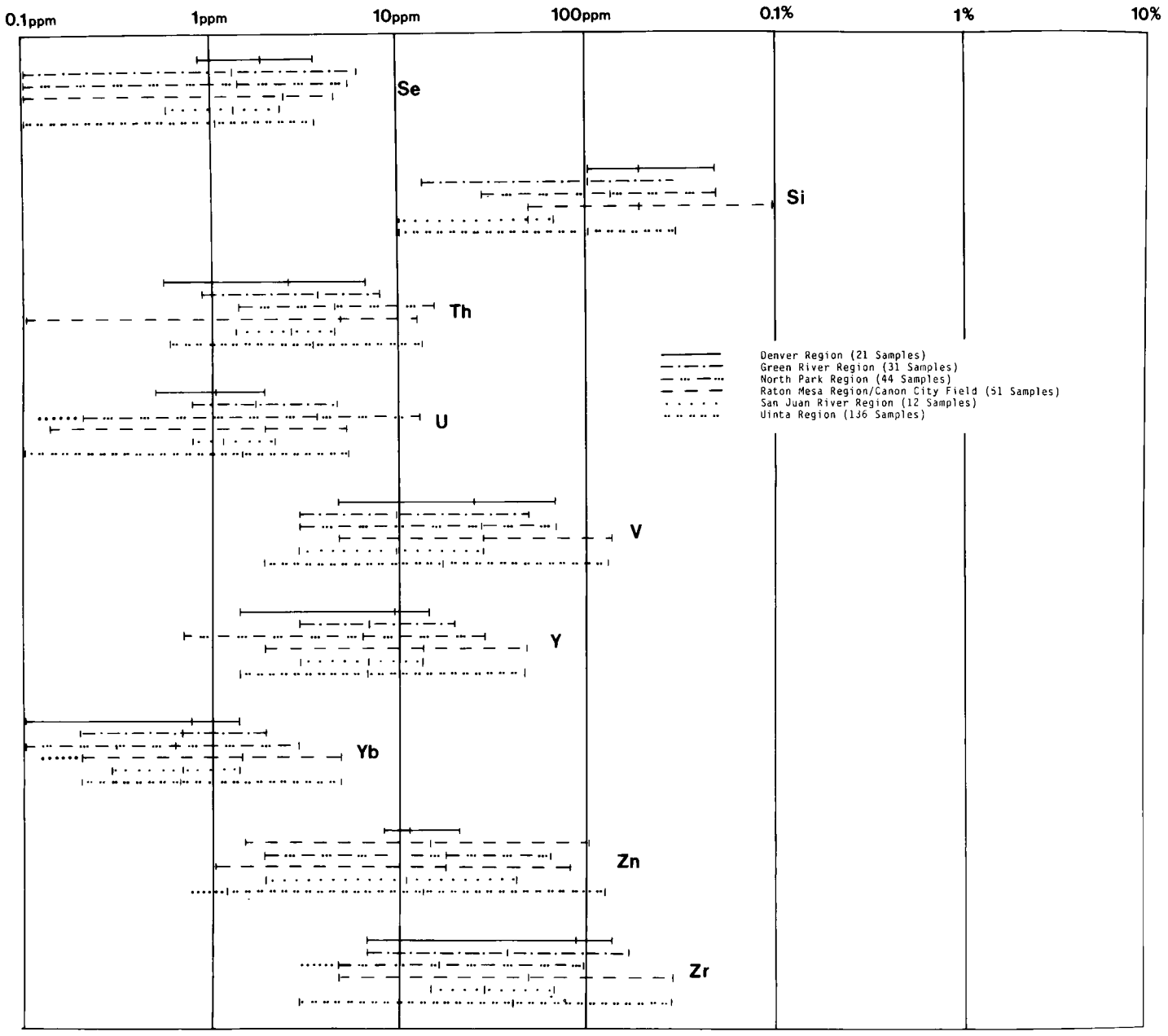

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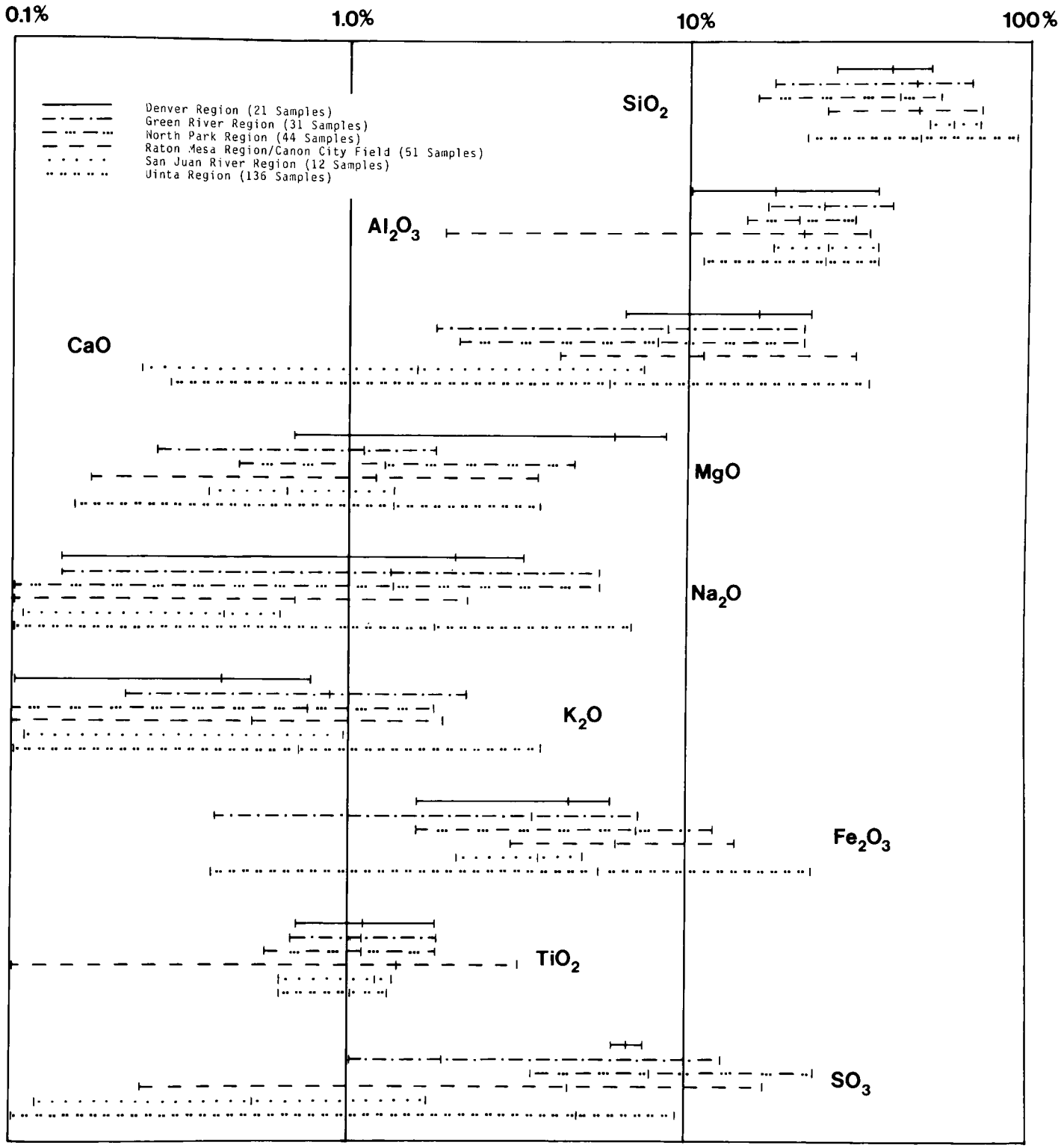

Figure 6. Arithmetic means and ranges for the contents of 10 oxides (ash basis) in laboratory ash from coal samples for the Denver, Green River, North Park, Raton Mesa (plus Canon City field), San Juan River, and Uinta Regions.

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Empire Energy Corp.
Energy Fuels Corp.
Exxon
Fuelco
Groves/Calder
H-G Coal Co.
Horner Coal Co.
Imogene Hastings
Imperial Coal Co.
Kerr Coal Co.
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Mobil Oil
Mynet Inc.
Northern Coal Co.
O. C. Mine Co.
Peabody Coal Co.
Sigma Mining Co.
Sunflower Energy Corp.
Twin Arrow Inc.
USGS Branch of Coal Resources
USGS Conservation Division
U.S. Steel Corp.
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Western Associated Coal Corp.
Western Slope Carbon

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Table 5. Sample data index with location, operator, stratigraphy,

Region	Field	County	Sec.	Twp.	Rge.	Mine/Operator	Mine Type or Drill Hole No.	Zone Name
Denver	Antelope Flats	Adams	34	2S	60W	CGS	4-C	Unnamed
			4	3S	61W	CGS	5-C	Unnamed
		Arapahoe	8	5S	65W	CGS	10-C	Unnamed
	Boulder-Weld	Weld	24	1N	68W	Lincoln	Underground	Unnamed
	Lowry	Arapahoe	30	4S	63W	Cameron Engineers	463-30-2C	"B", Bennet C
	Station Creek	Elbert	18	9S	61W	Cameron Engineers	961-18-1C	Watkins "E" Kiowa B
	Watkins	Adams	4	8S	62W	Cameron Engineers	862-4-1C	Bijou
			22	3S	65W	Cameron Engineers	365-22-1C	Watkins "E"
	Watkins-Lowry	Arapahoe	4	4S	64W	Mynet	BS #1	Uncorrelated Watkins "E"
Green River	Yampa	Routt	20	6N	86W	Denton Strip	Surface	Wadge
		Moffat	31	6N	91W	Eagle No. 5	Underground	"F"
		Routt	30	5N	88W	Hayden Gulch	Drill Hole	1 2 3 4 5
			26	5N	87W	Energy Fuels	W-35	Wadge
			35	5N	87W	Energy Fuels	W-36	Wadge
			13	5N	86W	Energy Fuels	W-47	Wolf Creek
			13	5N	36W	Energy Fuels	W-50	Wolf Creek A & B
		Moffat	23	4N	91W	USGS	C-1C-H	Unnamed
North Park	Coalmont	Jackson	32	7N	80W	Grizzly Creek	Surface	Riach
			19	7N	80W	USGS	C-9	Riach
			18	7N	80W	USGS	C-7	Riach
			15	7N	80W	USGS	M-5	Riach
	McCallum	Jackson	2	8N	78W	Canadian Strip	Surface	Sudduth Unnamed

sample numbers, lithology, apparent rank, and reference page.

Rock Unit	Age	CGS Field No.	USGS Number	USBM Number	Sample Type	Lithology	Rank	Page #
Laramie	Cretaceous	CGS-4C-1	D221579	K99284	Core	Coal	lig A	38
Laramie	Cretaceous	CGS-5C-1	D221580	K99285	Core	Coal	lig A	39
		CGS-5C-2	D221581	K99286	Core	Coal	lig A	40
Denver	Paleocene	CGS-10C-1	D221582	K99287	Core	Coal	lig A	41
Laramie	Cretaceous	77-DJ-1	D194465	K82755	Channel	Coal	sub A	42
		77-DJ-3	D194466	K82756	Channel	Coal	sub B	43
		77-DJ-4	D194467	K82757	Channel	Coal	sub B	44
Denver	Paleocene	CE 1			Core	Coal	sub C	45
		CE 2-6			Core	Coal	lig A	46
		CE 7			Core	Coal	lig A	46
Denver	Paleocene	CE 8-20			Core	Coal	lig A	47
Denver	Paleocene	CE 21-25			Core	Coal	lig A	48
		CE 26-28			Core	Coal	lig A	49
		CE 29-30			Core	Coal	lig A	50
Denver	Paleocene	CE 34-40			Core	Coal	lig A	51
Denver	Paleocene	CE 41-43			Core	Coal	lig A	52
		CE 44-50,55			Core	Coal	lig A	53
		CE 51			Core	Coal	lig A	53
Denver	Paleocene	CE 52-54			Core	Coal	lig A	54
Denver	Paleocene	Core 1		K94207	Core	Coal	lig A	55
		Core 2		K94208	Core	Coal	lig A	56
Mesaverde	Upper Cretaceous	76-DJ-21	D184642	K69862	Channel	Coal	sub A	70
		76-DJ-22	D184643	K69862	Floor	Rock	---	71
		76-DJ-23	D188240		Floor	Rock	---	71
		76-DJ-10	D188239		Floor	Rock	---	72
		76-DJ-12	D184639	K69861	Channel	Coal	hvC	73
		76-DJ-13	D184640	K69861	Channel	Coal	hvC	73
		76-DJ-14	D184641	K69861	Channel	Coal	hvC	73
Williams Fork	Upper Cretaceous	76-DKM-1	D188255	K72357	Channel	Coal	hvB	74
		76-DKM-2	D188256	K72357	Channel	Coal	hvB	75
		76-DKM-3	D188245		Floor	Rock	---	75
		76-DKM-4	D188246		Channel	Rock	---	75
Williams Fork	Upper Cretaceous	1			Core	Coal	sub B	76
		2			Core	Coal	sub B	77
		3			Core	Coal	sub B	77
		4			Core	Coal	sub B	77
		5			Core	Coal	sub B	77
Williams Fork	Upper Cretaceous	76-DJ-27	D184646	K69865	Core	Coal	hvC	78
Williams Fork	Upper Cretateous	76-DJ-26	D184645	K69864	Core	Coal	hvC	79
Williams Fork	Upper Cretaceous	76-DB-13	D188236		Core	Rock	---	80
		76-DB-14	D188252	K72355	Core	Coal	hvC	81
		76-DB-15	D188237		Core	Rock	---	81
		76-DB-17	D188238		Core	Rock	---	82
		76-DB-16	D188254	K72356	Core	Coal	hvC	83
		76-DB-12	D188253	K72356	Core	Coal	hvC	83
Williams Fork	Upper Cretaceous	76-DJ-28	D188250	K72353	Core	Coal	hvC	84
		76-DJ-29	D188251	K72354	Core	Coal	hvC	85
Williams Fork	Cretaceous	C-1C-H Run 1		K89040	Core	Coal	sub A	86
		Run 19		K89077	Core	Coal	hvC	87
		Run 28		K89078	Core	Coal	hvC	88
		Run 36		K89079	Core	Coal	hvC	89
		Run 41		K89080	Core	Coal	hvC	90
Coalmont	Eocene		D174481		Core	Coal	sub B	
			D174483		Core	Coal	sub B	
			D174484		Core	Coal	sub B	
			D174485		Core	Coal	sub B	
			D174486		Core	Coal	sub B	
Coalmont	Eocene		D194458		Core	Coal	sub B	
			D194485		Core	Rock	---	
Coalmont	Eocene		D194486		Core	Rock	---	
			D194459		Core	Coal	sub B	
			D194460		Core	Coal	sub B	
			D194461		Core	Coal	sub B	
			D194462		Core	Coal	sub B	
			D194487		Core	Rock	---	
Coalmont	Eocene		D194463		Core	Coal	sub C	
			D194488		Core	Rock	---	
			D194464		Core	Coal	sub B	
Coalmont	Paleocene		D170627		Channel	Coal	sub A	
			D170628		Channel	Coal	sub A	
			D170629		Channel	Coal	sub A	
			D170630		Channel	Coal	sub A	
			D170631		Channel	Coal	sub A	
Coalmont	Paleocene		D172059		Channel	Coal	sub A	

Table 5. (cont.)

Region	Field	County	Sec.	Twp.	Rge.	Mine/Operator	Mine Type or Drill Hole No.	Zone Name
North Park (Cont.)			26	9N	78W	Marr Strip	Surface	Sudduth
			19	9N	78W	USGS	G-9	Sudduth
			11	8N	78W	USGS	J-6B	Sudduth
			26	9N	78W	USGS	J-14	Sudduth
			8	9N	78W	USGS	E-7	Sudduth
			33	9N	78W	USGS	G-16	Sudduth
			8	8N	77W	USGS	J-2	Sudduth
			31	10N	78W	USGS	E-23	Unnamed Sudduth
Raton Mesa	Walsenburg	Huerfano	8	27S	67W	Groves/Calder	8-6	Prior
								Walsen
	Trinidad	Las Animas	16	30S	66W	Mobil	CT-78-16-1C	Delagua
			27	33S	68W	Allen	Underground Captive	Allen
			15	31S	65W	Delagua	Surface	Delagua
			21	30S	65W	Jewell Strip	Surface	Robinson #2
			29	33S	67W	Maxwell	Underground	Apache
			9	33S	66W	Mobil	MIE-4-CA	Unnamed
			21	33S	66W	Mobil	11C	Unnamed
			15	33S	66W	Mobil	9C	Unnamed
			29	33S	66W	Mobil	4C	Unnamed
			16	33S	67W	Mobil	CT-78-16-2C	Unnamed
			27	33S	66W	USGS	78-2A	Frederick/ Martinez
			36	33S	64W	USGS	78-4A	Unnamed
			29	34S	63W	CFI	29-1	Cokedale
			29	34S	63W	CFI	29-2	Cokedale
								Piedmont
								Morley

Rock Unit	Age	CGS Field No.	USGS Number	USBM Number	Sample Type	Lithology	Rank	Page #
Coalmont	Paleocene		D172052		Channel	Coal	sub A	
			D172053		Channel	Coal	sub A	
			D172054		Channel	Coal	sub A	
			D172055		Channel	Coal	sub A	
			D172056		Channel	Coal	sub A	
			D172057		Core	Coal	sub A	
			D172058		Core	Coal	sub A	
Coalmont	Paleocene		D196200		Core	Coal	sub B	
			D196201		Core	Coal	sub B	
Coalmont	Paleocene		D196202		Core	Coal	sub A	
Coalmont	Paleocene		D196203		Core	Coal	sub A	
			D196204		Core	Coal	sub A	
Coalmont	Paleocene		D196205		Core	Coal	sub B	
Coalmont	Paleocene		D196206		Core	Coal	sub B	
			D196441		Core	Rock	---	
Coalmont	Paleocene		D196442		Core	Rock	---	
			D196443		Core	Rock	---	
			D196207		Core	Coal	sub B	
			D196444		Core	Rock	---	
Coalmont	Paleocene		D196208		Core	Coal	sub B	
Coalmont	Paleocene		D196209		Core	Coal	sub B	
			D196210		Core	Coal	sub B	
Vermejo	Upper Cretaceous	76-DJ-5	D188241		Core	Rock	---	150
		76-DJ-6	D184634	K69857	Core	Coal	hvA	151
Vermejo	Upper Cretaceous	76-DJ-8	D184635	K69858	Core	Coal	hvC	152
		76-DJ-9	D188242		Core	Rock	---	153
Raton	Upper Cretaceous	78-CT-3	D205232	K88633	Core	Coal	hvA	154
Raton	Upper Cretaceous	SG-AM-1	D201450	K85444	Channel	Coal	hvA	155
		SG-AM-2	D201451	K85445	Channel	Coal	hvA	156
Raton	Cretaceous	78-SMG-6	D205219	K88426	Channel	Coal	hvA	157
		78-SMG-7	D205220	K88427	Channel	Coal	hvA	158
		78-SMG-8	D205218	K88425	Channel	Coal	hvC	159
Vermejo	Upper Cretaceous	78-JS-9	D205226	K88433	Channel	Coal	hvA	160
		78-JS-11	D205227	K88629	Channel	Coal	hvA	160
		78-SG-1	D205228	K88630	Channel	Coal	hvC	161
		78-SMG-2	D205221	K88428	Channel	Coal	hvA	162
		78-SMG-3	D205222	K88429	Channel	Coal	hvA	162
		78-SMG-4	D205223	K88430	Channel	Coal	hvA	163
		78-SMG-5	D205224	K88431	Channel	Coal	hvA	164
		78-SMG-10	D205225	K88432	Channel	Coal	hvA	164
Raton	Upper Cretaceous	SG-MM-1	D201447	K85441	Channel	Coal	hvA	164
		SG-MM-2	D201448	K85442	Channel	Coal	hvA	164
		SG-MM-3	D201449	K85443	Channel	Coal	hvA	165
Raton	Cretaceous	MIE-4-CA	D180092	K68966	Core	Coal	hvA	166
Raton	Cretaceous	Mobil 11C	D180090	K68964	Core	Coal	hvA	166
Raton	Cretaceous	Mobil 9C	D180089	K68963	Core	Coal	hvA	167
Raton	Cretaceous	Mobil 14C	D180091	K68965	Core	Coal	hvA	168
Raton	Upper Cretaceous	78-CT-1	D205231	K88632	Core	Coal	hvA	169
		78-CT-2	D205230	K88631	Core	Coal	hvA	170
Raton	Cretaceous	Run 4		K86616	Core	Coal	mv	171
		Run 6		K86617	Core	Coal	hvA	172
Vermejo	Cretaceous	Run 2		K86618	Core	Coal	mv	173
		Run 3		K86619	Core	Coal	mv	174
Vermejo	Cretaceous	Run 1		K85037	Core	Coal	hvA	175
		Run 2, Upper		K89038	Core	Coal	hvA	176
		Run 2, Lower		K89039	Core	Coal	hvA	177
		Run 3		K90194	Core	Coal	hvA	178
		Run 4		K90195	Core	Coal	hvA	179
		Run 5		K89074	Core	Coal	hvA	179
Vermejo	Cretaceous	Run 1, Upper		K88878	Core	Coal	hvA	180
		Run 1, Lower		K89372	Core	Coal	hvA	181
Vermejo	Cretaceous	Run 3, Upper		K88879	Core	Coal	hvA	182
		Run 3, Lower		K89024	Core	Coal	hvA	183
Vermejo	Cretaceous	Run 4, Upper		K89025	Core	Coal	hvB	184
		Run 4, Lower		K89042	Core	Coal	hvA	185
		Run 5		K89026	Core	Coal	hvA	185
		Run 6		K89027	Core	Coal	hvA	185

Table 5 (cont.)

Region	Field	County	Sec.	Twp.	Rge.	Mine/Operator	Mine Type or Drill Hole No.	Zone Name
	Canon City	Fremont	19	20S	69W	Hastings Strip	Surface	Unnamed Little Johnnie
			19	20S	69W	Roadcut by GEC		Zenith Unnamed
San Juan	Durango	La Plata	31	35N	11W	Blue Flame	Underground	Pueblo
			26	35N	12W	Calder & Co.	C-26	Unnamed
			36	35N	12W	Calder & Co.	C-36	Unnamed
	Nucla/ Naturita	Montrose	36	47N	16W	Nucla Strip	Surface	Unknown
	Pagosa Springs	Archuleta	30	33 1/2N	4W	Martinez	Surface	"C"
								"B"
								"A"
Uinta	Carbondale	Pitkin	15	10S	89W	Coal Basin	Underground	Coal Basin "B"
			17	10S	89W	Dutch Creek #1	Underground	"B"
			16	10S	89W	Dutch Creek #2	Underground	Dutch Creek
		Garfield	34	7S	89W	Sunlight	Underground	A, C & D
		Pitkin	35	8S	89W	Thompson Creek #1	Underground	"A"
			34	8S	89W	Thompson Creek #3	Underground	Upper Sunshine
			8	10S	89W	L. S. Wood	Underground	Coal Basin "B"
		Mesa	10	10S	93W	Exxon	Vega 3	Unnamed
	Cathedral	Rio Blanco	28	3S	101W	Fuelco	O-28-3-101-S	Unknown
			14	3S	101W	Twin Arrow	C&K 4-14	Unnamed
	Crested Butte	Gunnison	33	13S	86W	Horace	Underground	Cheyenne
			16	15S	86W	O.C. No. 2	Underground	"C" Kubler
			28	13S	86W	Peanut	Underground	Unnamed
	Danforth Hills	Moffat	4	3N	93W	Colowyo Strip	Surface	Y_3 Y_2 X A_2 A_3 B C D E F
		Rio Blanco	29	2N	93W	Rienau #2	Underground	Rienau #2
			21	2N	93W	Northern Coal	77-26C-NN	Upper D
		Moffat	18	4N	94W	USGS	D-38-EG	Unknown
	Grand Hogback	Garfield	24	5S	92W	Eastside	Underground	"E"

Rock Unit	Age	CGS Field No.	USGS Number	USBM Number	Sample Type	Lithology	Rank	Page #
Vermejo	Cretaceous	78-JH-1	D201446	K85453	Coal log	Coal	hvC	186
Vermejo	Upper Cretaceous	78-JS-1	D201440	K85448	Channel	Coal	hvC	187
		78-JS-2	D201441	K85449	Channel	Coal	hvC	188
		78-JS-4	D201442	K85450	Channel	Coal	hvC	189
Vermejo	Upper Cretaceous	78-JS-6	D201444	K85451	Channel	Coal	hvC	190
Vermejo	Cretaceous	78-JS-7	D201445	K85452	Channel	Coal	hvC	191
Menefee	Upper Cretaceous	78-CGS-4	D205240	K88641	Core	Coal	hvB	220
Menefee	Upper Cretaceous	76-H-1	D180093	K68967	Core	Coal	hvA	221
Menefee	Upper Cretaceous	76-H-2	D180094	K68968	Core	Coal	hvA	222
Dakota	Cretaceous	78-CGS-2	D205241	K88642	Channel	Coal	hvB	223
		78-CGS-3	D205242	K88643	Channel	Coal	hvA	224
U. Fruitland	Upper Cretaceous	78-CGS-5	D205237	K88638	Channel	Coal	hvA	225
		78-CGS-6	D205238	K88639	Channel	Coal	hvA	226
		78-CGS-8	D205239	K88640	Channel	Coal	hvA	226
U. Fruitland	Upper Cretaceous	78-CGS-9	D205234	K88635	Channel	Coal	hvA	227
		78-CGS-11	D205235	K88636	Channel	Coal	hvA	228
		78-CGS-13	D205236	K88637	Channel	Coal	hvA	228
U. Fruitland	Upper Cretaceous	78-CGS-14	D205233	K88634	Channel	Coal	hvB	229
Williams Fork	Upper Cretaceous	77-DJ-18	D196222	K84727	Channel	Coal	mv	251
		77-DJ-19	D196221	K84726	Channel	Coal	mv	252
		77-DJ-20	D196438		Channel	Coal	---	252
L. Mesaverde	Upper Cretaceous	76-DJ-19	D184637	K69860	Channel	Coal	mv	253
		76-DJ-20	D184638	K69860	Channel	Coal	mv	254
Williams Fork	Upper Cretaceous	77-DJ-15	D196219	K84724	Channel	Coal	mv	255
		77-DJ-16	D196437		Parting	Rock	---	256
		77-DJ-17	D196220	K84775	Channel	Coal	mv	256
L. Mesaverde	Upper Cretaceous	76-DJ-7	D184636	K69859	Tipple	Coal	hvB	257
Williams Fork	Upper Cretaceous	78-CGS-20	D208589	K92112	Channel	Coal	hvA	258
		78-CGS-21	D208589	K92112	Channel	Coal	hvA	259
		78-CGS-22	D208589	K92112	Channel	Coal	hvA	259
Williams Fork	Upper Cretaceous	78-CGS-23	D208590	K92113	Channel	Coal	hvA	260
		78-CGS-24	D208590	K92113	Channel	Coal	hvA	261
		78-CGS-25	D208590	K92113	Channel	Coal	hvA	261
Williams Fork	Upper Cretaceous	77-DJ-21	D196223	K84728	Channel	Coal	mv	262
Mesaverde	Cretaceous	Core 2		K99779	Core	Coal	mv	263
		Core 3		K99780	Core	Coal	mv	264
Mesaverde	Cretaceous	78-CGS-33		K90196	Core	Coal	hvA	265
		78-CGS-29		K90197	Core	Coal	hvB	266
Mesaverde	Cretaceous	27		K92140	Core	Coal	hvB	267
		29		K92139	Core	Coal	hvB	268
		38		K92143	Core	Coal	hvB	269
		36		K92141	Core	Coal	hvB	270
		24		K92142	Core	Coal	hvB	271
Mesaverde	Cretaceous	78-CGS-18	D208587	K92110	Grab	Coal	sa	272
Mesaverde	Upper Cretaceous	78-CGS-17	D208586	K92109	Channel	Coal	hvC	273
Mesaverde	Cretaceous	78-CGS-19	D208588	K92111	Grab	Coal	sa	274
Williams Fork	Upper Cretaceous				Core	Coal	sub A	276
					Core	Coal	sub A	276
					Core	Coal	sub A	276
					Core	Coal	sub A	276
					Core	Coal	sub A	276
					Core	Coal	sub A	277
					Core	Coal	sub A	277
					Core	Coal	hvC	277
					Core	Coal	hvC	277
					Core	Coal	hvC	277
Mesaverde	Cretaceous	78-NBR-1	D208585	K92108	Tipple	Coal	hvC	278
Williams Fork	Cretaceous	CGS Core 1		K76536	Core	Coal	hvC	279
Williams Fork	Cretaceous	Run 1		K89044	Core	Coal	hvC	280
		Run 2		K89045	Core	Coal	hvC	281
		Run 3		K89041	Core	Coal	hvC	281
		Run 4		K89043	Core	Coal	hvC	282
		Run 5		K89046	Core	Coal	hvC	283
Mesaverde	Cretaceous	77-DJ-8	D196216	K84721	Channel	Coal	hvB	284
		77-DJ-11	D196217	K84722	Channel	Coal	hvB	285
		77-DJ-5	D196214	K84719	Channel	Coal	hvB	285
		77-DJ-6	D196215	K84720	Channel	Coal	hvB	285
		77-DJ-7	D196434		Parting	Rock	---	285

Table 5. (cont.)

Region	Field	County	Sec.	Twp.	Rge.	Mine/Operator	Mine Type or Drill Hole No.	Zone Name
			24	5S	92W	NuGap #3	Underground	Sunny Ridge
	Grand Mesa	Delta	8	13S	93W		Mine	Unknown
			15	13S	93W		Mine	Unknown
			22	13S	93W		Mine	Unknown
			12	13S	95W		Mine	Unknown
			13	13S	95W		Mine	Unknown
			15	13S	94W		Mine	Unknown
			27	13S	92W		Mine	Unknown
			20	13S	92W	USGS	Drill Hole	Unknown
			19	13S	92W	USGS	Drill Hole	Unknown
			24	13S	93W	USGS	Drill Hole	Unknown
			8	13S	93W	USGS	Drill Hole	Unknown
			1	13S	94W	USGS	Drill Hole	Unknown
			15	13S	94W	USGS	Drill Hole	Unknown
			8	13S	95W	USGS	Drill Hole	Unknown
			25	13S	96W	USGS	Drill Hole	Unknown
			24	13S	96W	USGS	Drill Hole	Unknown
			32	13S	96W	USGS	Drill Hole	Unknown
		Mesa	34	10S	98W		Mine	Unknown
			34	10S	98W		Mine	Unknown
			21	12S	97W	USGS	Drill Hole	Unknown
			13	10S	98W	USGS	Drill Hole	Unknown
	Somerset	Gunnison	9	13S	90W	Bear	Underground	"C"
			11	13S	90W	Hawk's Nest East	WSC #5	Wild
								"D"
								"C"
								"B"
						Hawk's Nest East	WSC #6	"B", Upper
						Hawk's Nest East	WSC #7	"C"
								"B"
						Hawk's Nest East	WSC #8	Wild Seam, D
								"C"
								"B"
						Hawk's Nest #3	Underground	"E"
			8	13S	90W	Somerset	Underground	"B"

Rock Unit	Age	CGS Field No.	USGS Number	USBM Number	Sample Type	Lithology	Rank	Page #
Mesaverde	Upper Cretaceous	77-DJ-12	D196218	K84723	Channel	Coal	hvB	286
		77-DJ-13	D196435		Roof	Rock	---	287
		77-DJ-14	D196436		Floor	Rock	---	287
Mesaverde	Cretaceous		D191607		Channel	Coal	hvB	
Mesaverde	Cretaceous		D194452		Channel	Coal	hvC	
Mesaverde	Cretaceous		D194453		Channel	Coal	sub A	
Mesaverde	Cretaceous		D194454		Channel	Coal	hvC	
Mesaverde	Cretaceous		D194455		Channel	Coal	hvC	
Mesaverde	Cretaceous		D194456		Channel	Coal	hvC	
Mesaverde	Cretaceous		D194457		Channel	Coal	hvC	
Mesaverde	Cretaceous		D203116		Core	Coal	hvC	
			D203117		Core	Coal	hvC	
			D203118		Core	Coal	hvC	
			D203119		Core	Coal	hvC	
Mesaverde	Cretaceous		D203113		Core	Coal	hvC	
			D203114		Core	Coal	hvC	
			D203115		Core	Coal	hvC	
Mesaverde	Cretaceous		D203120		Core	Coal	hvC	
Mesaverde	Cretaceous		D203109		Core	Coal	hvC	
			D203110		Core	Coal	hvC	
			D203111		Core	Coal	hvC	
			D203112		Core	Coal	hvC	
Mesaverde	Cretaceous		D203106		Core	Coal	hvC	
			D203107		Core	Coal	hvC	
			D203108		Core	Coal	hvC	
Mesaverde	Cretaceous		D203100		Cuttings	Coal	sub A	
			D203002		Cuttings	Coal	sub A	
			D203003		Cuttings	Coal	sub A	
			D203005		Cuttings	Coal	sub A	
Mesaverde	Cretaceous		D203095		Core	Coal	sub A	
Mesaverde	Cretaceous		D203096		Core	Coal	sub A	
			D203098		Core	Coal	sub A	
			D203099		Core	Coal	sub A	
Mesaverde	Cretaceous		D203091		Core	Coal	sub B	
			D203092		Core	Coal	sub A	
			D203093		Core	Coal	sub B	
			D203094		Core	Coal	sub B	
Mesaverde	Cretaceous		D203089		Core	Coal	sub B	
			D203090		Core	Coal	sub B	
Mesaverde	Cretaceous		D180095		Channel	Coal	hvB	
			D180096		Channel	Coal	---	
Mesaverde	Cretaceous		D184655		Channel	Coal	hvB	
			D184656		Channel	Coal	---	
Mesaverde	Cretaceous		D203087		Core	Coal	sub A	
			D203088		Core	Coal	sub A	
Mesaverde	Cretaceous		D203083		Core	Coal	hvA	
			D203084		Core	Coal	hvA	
			D203086		Core	Coal	hvA	
L. Mesaverde	Upper Cretaceous	76-DB-1	D184650	K69867	Channel	Coal	hvB	288
		76-DB-2	D184651	K69867	Channel	Coal	hvB	289
Mesaverde	Cretaceous	WSC #5 1A		K92144	Core	Coal	hvA	290
		78-SMG-102	D216420	K99929	Core	Coal	hvB	291
		1B		K94209	Core	Coal	hvA	291
		1C		K95626	Core	Coal	hvA	291
		78-SMG-103	D216424	K99932	Core	Coal	hvA	291
		WSC #5 1D		K95630	Core	Coal	hvA	292
		78-SMG-106	D216477	K99935	Core	Coal	hvA	293
		1E		K92145	Core	Coal	hvA	294
		1F		K95971	Core	Coal	hvA	295
		1H		K95973	Core	Coal	hvA	295
		1I		K95974	Core	Coal	hvA	295
		1J		K94210	Core	Coal	hvA	295
Mesaverde-		78-CGS-106		K94211	Core	Coal	hvA	296
Bowie Member		CGS-107		K95632	Core	Coal	hvA	297
		CGS-108		K95627	Core	Coal	hvA	298
Mesaverde-		CGS-109		K95977	Core	Coal	hvA	299
Bowie Member		CGS-110		K95975	Core	Coal	hvA	300
		CGS-111		K95976	Core	Coal	hvA	301
Mesaverde-	Cretaceous	CGS-112		K95625	Core	Coal	hvA	302
Paonia Member		CGS-113		K95628	Core	Coal	hvA	303
		CGS-114		K95629	Core	Coal	hvA	303
Mesaverde-	Cretaceous	CGS-115		K95983	Core	Coal	hvA	304
Bowie Member		CGS-116			Core	Coal	hvA	305
Mesaverde-	Cretaceous	CGS-117		K95978	Core	Coal	hvA	306
Bowie Member		CGS-118		K95631	Core	Coal	hvA	307
		CGS-119		K95982	Core	Coal	hvA	307
		CGS-120		K95633	Core	Coal	hvA	307
Mesaverde	Upper Cretaceous	76-DB-3	D184652	K69868	Channel	Coal	hvB	308
		76-DB-4	D188247		Parting	Rock	---	309
		76-DB-5	D184653	K69869	Channel	Coal	hvB	309
		76-DB-6	D184654	K69869	Channel	Coal	hvB	309
		76-DB-7	D188248		Floor	Rock	---	309
Mesaverde	Upper Cretaceous	76-DJ-15	D184647	K69866	Channel	Coal	hvB	310
		76-DJ-16	D184648	K69866	Channel	Coal	hvA	311
		76-DJ-17	D184649	K69866	Channel	Coal	hvA	311
		76-DJ-18	D188249		Roof	Rock	---	311

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PART II

Section A
Chemical Analyses of Coal Samples from the Denver Region

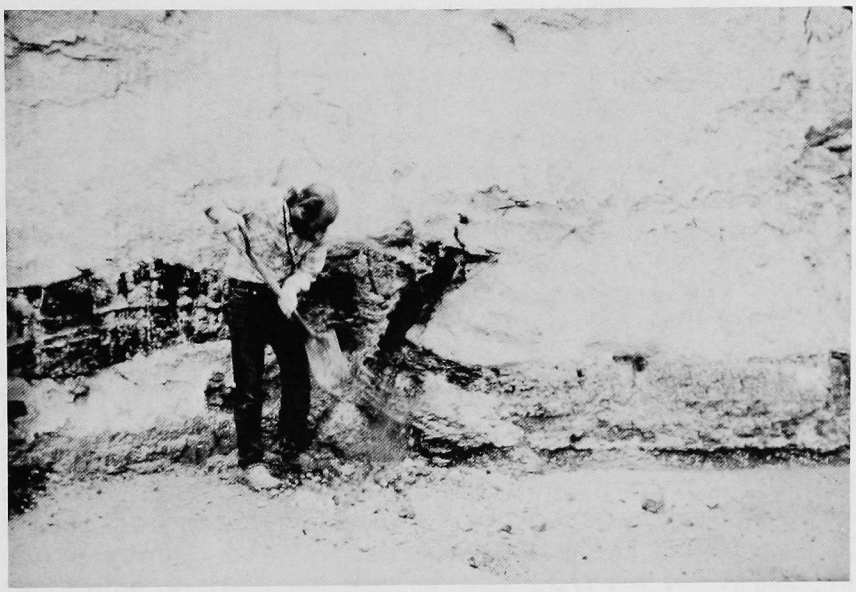


Figure A-1. A Denver region lignite bed near Station Creek, Elbert County.

Denver Region

The Denver coal region extends north-south from near Greeley to just south of Colorado Springs and from the Front Range to the East for about 50 miles. The region typically has low relief in an area of plains and tablelands with high-angle reverse faults and steep east dipping beds common on the western margin of the basin associated with the Front Range uplift. Most beds have shallow dips throughout the rest of the basin. The Denver region is separated from the Cheyenne Basin by the Greeley Arch (Landis, 1959). There are about 14,000 feet of sediments in the region. Coal beds occur in the Laramie and Denver Formations of Upper Cretaceous and Paleocene ages (see figure A3).

Analyses for a total of 21 coal samples are included in this section. Of these, 3 coal samples are from the Lincoln mine and the other 18 coal samples were collected from core-drilling projects. Only seven of these coal samples have been analyzed for trace elements by the U.S. Geological Survey. The distribution of sample locations is shown in figure A2. Because of the sparsity of coal analyses in this region, the statistical data at the end of this section should be considered a summary of these analyses only and should not be construed as to be representative of the entire basin. The ash content of many of these drill core samples runs higher than one would expect to find in coal mine samples. This is due to the selective nature of the exploration process involved in the location of a mineable coal bed. These coal samples range in rank from lignite A to subbituminous A.

The historical records show that there have been 387 coal mines in the Denver region which produced over 130 million tons of coal (Boreck and Murray, 1979). In 1978, the Lincoln mine in Weld County produced almost 73,000 tons of coal. In 1979, there was no coal production from this region. As of November, 1980 there is one producing coal mine, the Bacon Strip. According to Boreck and Murray (1979) the remaining demonstrated coal reserve base in the region is about 3.75 billion tons.

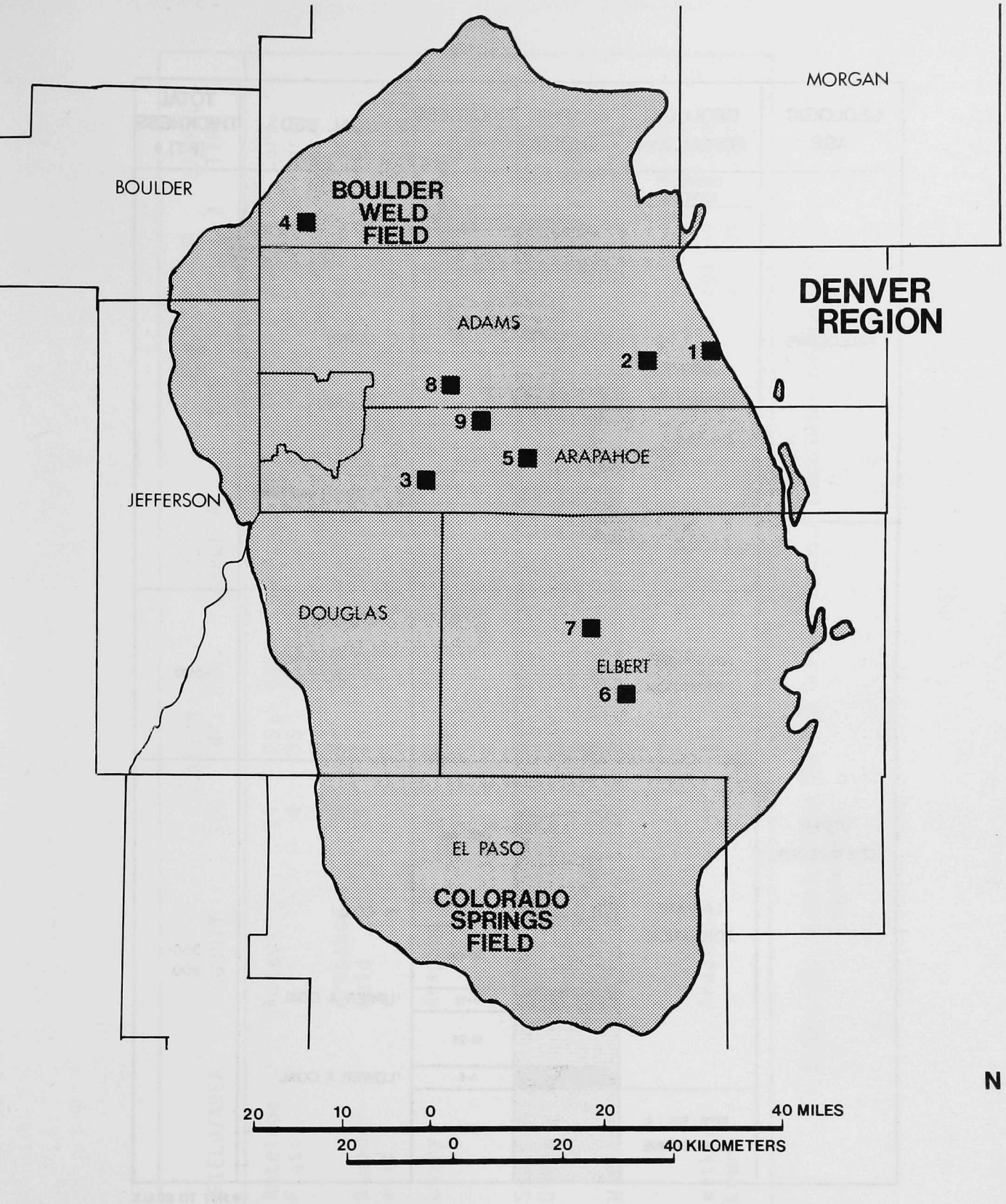


Figure A2. Location of samples within the Denver Region.

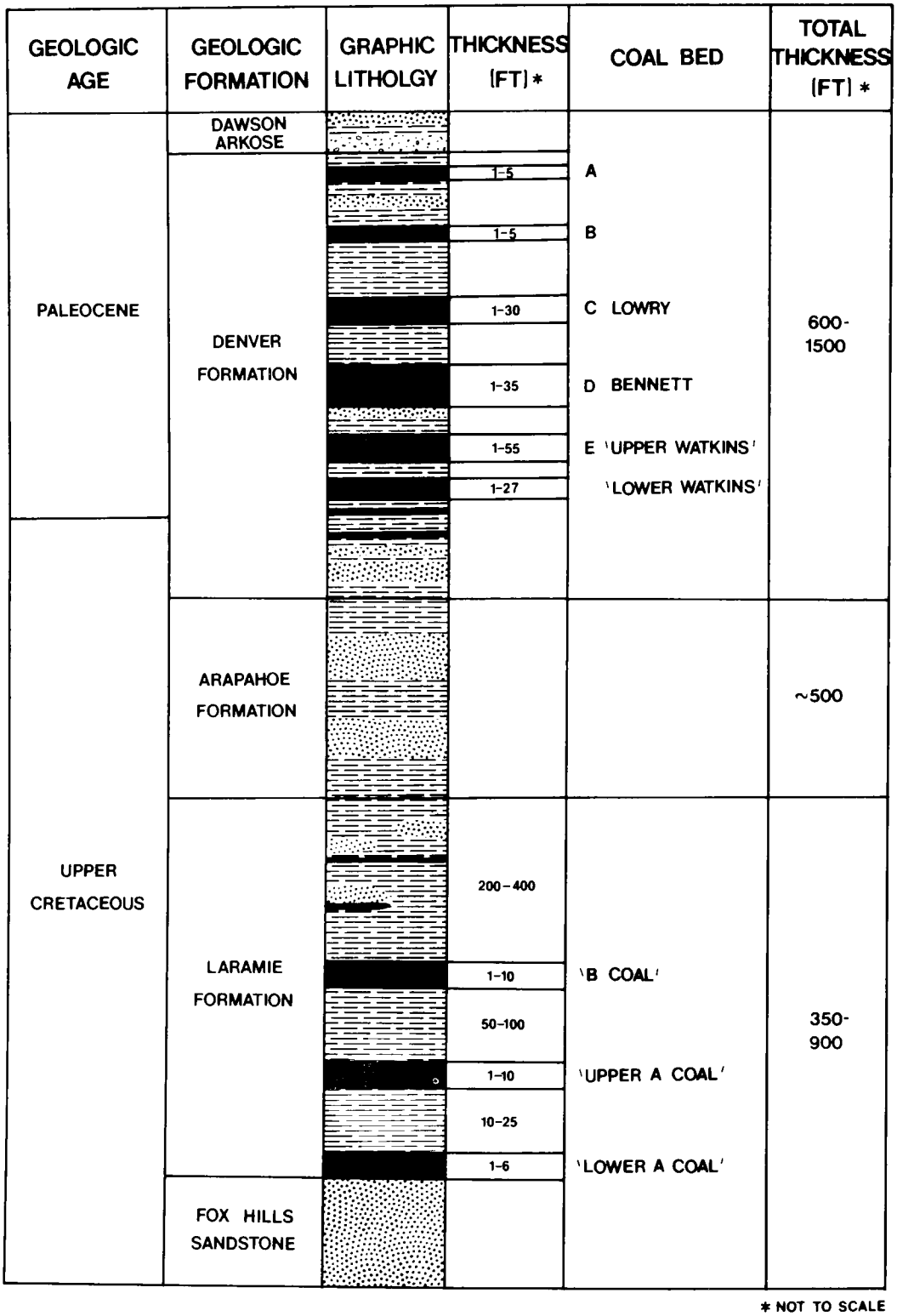


Figure A3. Generalized stratigraphic section showing the coal-bearing rocks in the Denver Region (after Brand, 1980).

MAP INDEX #	FIELD/AREA	COUNTY	LOCATION SEC.	TWP.	RGE.	CGS SAMPLE #	USGS SAMPLE #	US DOE SAMPLE #	SAMPLE TYPE
1	Antelope	Adams	34	2S	60W	CGS-4C-1	D221579	K99284	Core
2	Flats		4	3S	61W	CGS-5C-1	D221580	K99285	Core
						CGS-5C-2	D221581	K99286	Core
3		Arapahoe	8	5S	65W	CGS-10C-1	D221582	K99287	Core
4	Boulder-Weld	Weld	24	1N	68W	77-DJ-1	D194465	K82755	Channel
						77-DJ-3	D194466	K82756	Channel
						77-DJ-4	D194467	K82757	Channel
5	Lowry	Arapahoe	30	4S	63W	CE 1			Core
						CE 2-6			Core
						CE 7			Core
						CE 8-20			Core
6	Station Creek	Elbert	18	9S	61W	CE 21-25			Core
						CE 26-28			Core
						CE 29-33			Core
7			4	8S	62W	CE 34-40			Core
8	Watkins	Adams	22	3S	65W	CE 41-43			Core
						CE 44-50,55			Core
						CE 51			Core
						CE 52-54			Core
9	Watkins-Lowry	Arapahoe	4	4S	64W	Core 1		K94207	Core
						Core 2		K94208	Core

Figure A4. Sample index for the Denver Region. (Map index number refers to figure A2.)

DENVER REGION
ANTELOPE FLATS AREA

ADAMS COUNTY

SAMPLE NUMBER: CGS-4C-1

COAL BED NAME: Unnamed

GEOLOGIC ROCK UNIT: Laramie Fm

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 133 Meters: 40.5

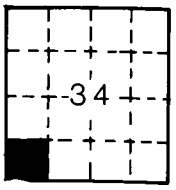
OVERBURDEN AT SAMPLING POINT:
Feet: 109 Meters: 33.2

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 34

TOWNSHIP: 2 S

RANGE: 60 W

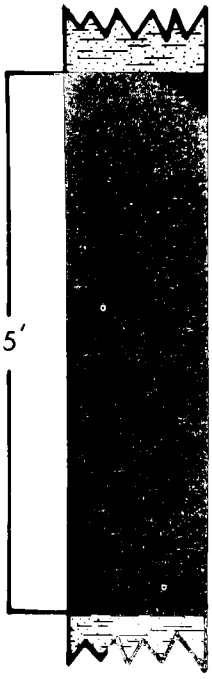
USGS TOPOGRAPHIC QUADRANGLE:
Leader SE 7.5' (1951)

DRILL HOLE NO.: CGS-4C

MINE TYPE: --

OPERATOR/OWNER: Colorado Geological Survey

COAL BED NAME UNKNOWN



COAL: Sample No. CGS-4C-1, lignitic.

ANALYSES LABORATORY NUMBERS
USBM/DOE: K99284
USGS: D221579

APPARENT RANK OF COAL:
Lignite A

THICKNESS OF COAL:
Feet: 5 Meters: 1.5

THICKNESS SAMPLED:
Feet: 5 Meters: 1.5

TYPE OF SAMPLE: Drill Core: Coal

DENVER REGION
ANTELOPE FLATS AREA

ADAMS COUNTY

SAMPLE NUMBER: CGS-5C-1

COAL BED NAME: Unnamed

GEOLOGIC ROCK UNIT: Laramie Fm

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 325 Meters: 99.0

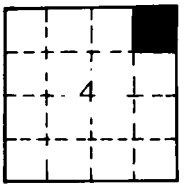
OVERBURDEN AT SAMPLING POINT:
Feet: 305 Meters: 92.4

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 4

TOWNSHIP: 3 S

RANGE: 61 W

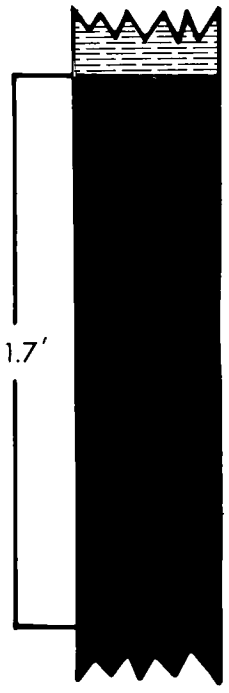
USGS TOPOGRAPHIC QUADRANGLE:
Leader SW 7.5' (1952)

DRILL HOLE NO.: CGS-5C

MINE TYPE: --

OPERATOR/OWNER: Colorado Geological Survey

COAL BED NAME UNKNOWN



SHALE

COAL: Sample No. CGS 5C-1, lignitic.

ANALYSES LABORATORY NUMBERS
USBM/DOE: K99285
USGS: D221580

APPARENT RANK OF COAL:
Lignite A

THICKNESS OF COAL:
Feet: 6.7 Meters: 2.0

THICKNESS SAMPLED:
Feet: 1.7 Meters: 0.5

TYPE OF SAMPLE: Drill Core: Coal

DENVER REGION
ANTELOPE FLATS AREA

ADAMS COUNTY

SAMPLE NUMBER: CGS-5C-2

COAL BED NAME: Unnamed

GEOLOGIC ROCK UNIT: Laramie Fm

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 325 Meters: 99.0

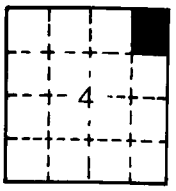
OVERBURDEN AT SAMPLING POINT:
Feet: 362.5 Meters: 110.5

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 4

TOWNSHIP: 3 S

RANGE: 61 W

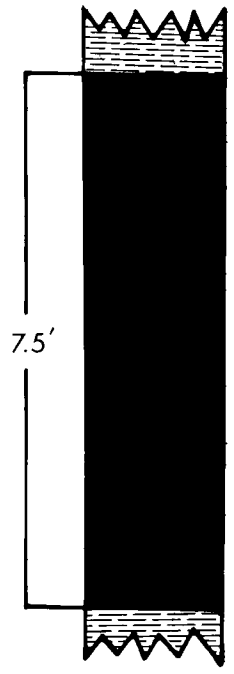
USGS TOPOGRAPHIC QUADRANGLE:
Leader SW 7.5' (1952)

DRILL HOLE NO.: CGS-5C

MINE TYPE: --

OPERATOR/OWNER: Colorado Geological Survey

COAL BED NAME UNKNOWN



INTERBEDDED SANDSTONE AND SHALE

COAL: Sample No. CGS 5C-2, lignitic.

SHALE

ANALYSES LABORATORY NUMBERS
USBM/DOE: K99286
USGS: D221581

APPARENT RANK OF COAL:
Lignite A

THICKNESS OF COAL:
Feet: 7.5 Meters: 2.4

THICKNESS SAMPLED:
Feet: 7.5 Meters: 2.3

TYPE OF SAMPLE: Drill Core: Coal

DENVER REGION
ANTELOPE FLATS AREA

ADAMS COUNTY

SAMPLE NUMBER: CGS-10C-1

COAL BED NAME: Unnamed

GEOLOGIC ROCK UNIT: Denver Fm

GEOLOGIC AGE: Paleocene

TOTAL SECTION MEASURED:
Feet: 511.3 Meters: 155.9

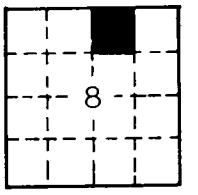
OVERBURDEN AT SAMPLING POINT:
Feet: 439 Meters: 134

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 8

TOWNSHIP: 5 S

RANGE: 65 W

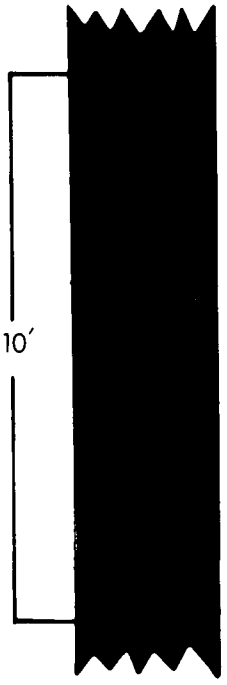
USGS TOPOGRAPHIC QUADRANGLE:
Coal Creek 7.5' (1966)

DRILL HOLE NO.: CGS-10C

MINE TYPE: --

OPERATOR/OWNER: Colorado Geological Survey

COAL BED NAME UNKNOWN



COAL: lignitic, reworked, some kaolinite.

COAL: Sample No. CGS 10C-1, brown, lignitic, some attritus, occasional fractures.

COAL: lignitic, reworked, sandy, coaly fragments.

ANALYSES LABORATORY NUMBERS
USBM/DOE: K99287
USGS: D221582

APPARENT RANK OF COAL:
Lignite A

THICKNESS OF COAL:
Feet: 19.4 Meters: 5.9

THICKNESS SAMPLED:
Feet: 10 Meters: 3.0

TYPE OF SAMPLE: Drill Core: Coal

DENVER REGION
BOULDER-WELD FIELD

WELD COUNTY

SAMPLE NUMBER: 77-DJ-1

COAL BED NAME: Unnamed

GEOLOGIC ROCK UNIT: Laramie Fm

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: -- Meters: --

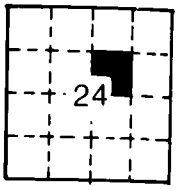
OVERBURDEN AT SAMPLING POINT:
Feet: -- Meters: --

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 24

TOWNSHIP: 1 N

RANGE: 68 W

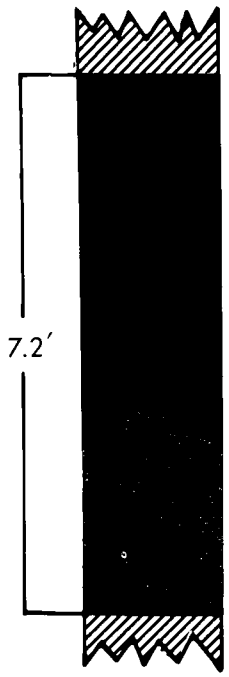
USGS TOPOGRAPHIC QUADRANGLE:
Frederick 7.5' (1969)

MINE NAME: Lincoln

MINE TYPE: Underground

OPERATOR/OWNER: Imperial Coal Co.

COAL BED NAME UNKNOWN



COAL: Sample No. 77-DJ-1.

ANALYSES LABORATORY NUMBERS
USBM/DOE: K82755
USGS: D194465

APPARENT RANK OF COAL:
Subbituminous B

THICKNESS OF COAL:
Feet: 6-12 Meters: 1.8-3.7

THICKNESS SAMPLED:
Feet: 7.2 Meters: 2.2

TYPE OF SAMPLE: Coal-channel

DENVER REGION
BOULDER-WELD FIELD

WELD COUNTY

SAMPLE NUMBER: 77-DJ-3

COAL BED NAME: Unnamed

GEOLOGIC ROCK UNIT: Laramie Fm

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: -- Meters: --

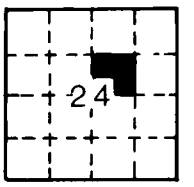
OVERBURDEN AT SAMPLING POINT:
Feet: -- Meters: --

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 24

TOWNSHIP: 1 N

RANGE: 68 W

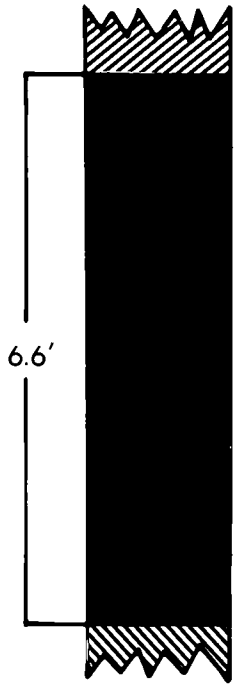
USGS TOPOGRAPHIC QUADRANGLE:
Frederick 7.5' (1969)

MINE NAME: Lincoln

MINE TYPE: Underground

OPERATOR/OWNER: Imperial Coal Co.

COAL BED NAME UNKNOWN



COAL: Sample No. 77-DJ-3.

ANALYSES LABORATORY NUMBERS
USBM/DOE: K82756
USGS: D194466

APPARENT RANK OF COAL:
Subbituminous B

THICKNESS OF COAL:
Feet: 6-12 Meters: 1.8-3.7

THICKNESS SAMPLED:
Feet: 6.6 Meters: 2.0

TYPE OF SAMPLE: Coal-channel

DENVER REGION
BOULDER-WELD FIELD

WELD COUNTY

SAMPLE NUMBER: 77-DJ-4

COAL BED NAME: Unnamed

GEOLOGIC ROCK UNIT: Laramie Fm

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: -- Meters: --

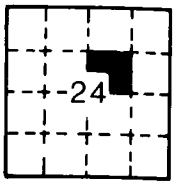
OVERBURDEN AT SAMPLING POINT:
Feet: -- Meters: --

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 24

TOWNSHIP: 1 N

RANGE: 68 W

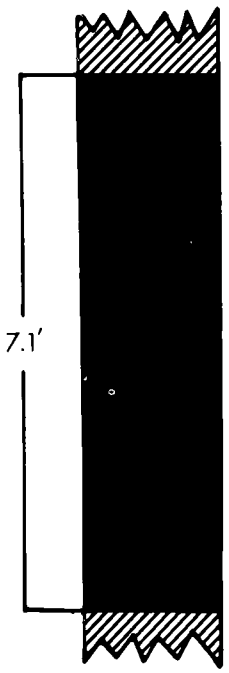
USGS TOPOGRAPHIC QUADRANGLE:
Frederick 7.5' (1969)

MINE NAME: Lincoln

MINE TYPE: Underground

OPERATOR/OWNER: Imperial Coal Co.

COAL BED NAME UNKNOWN



COAL: Sample No. 77-DJ-4.

ANALYSES LABORATORY NUMBERS
USBM/DOE: K82757
USGS: D1994467

APPARENT RANK OF COAL:
Subbituminous B

THICKNESS OF COAL:
Feet: 6-12 Meters: 1.8-3.7

THICKNESS SAMPLED:
Feet: 7.1 Meters: 2.15

TYPE OF SAMPLE: Coal-channel

DENVER REGION
LOWRY FIELD

ARAPAHOE COUNTY

SAMPLE NUMBERS: CE 1,2-6,7

COAL BED NAME: "B", Bennet "C"

GEOLOGIC ROCK UNIT: Denver Fm

GEOLOGIC AGE: Paleocene

TOTAL SECTION MEASURED:
Feet: 44.4 Meters: 13.5

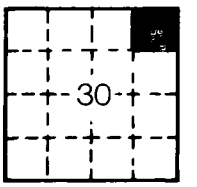
OVERBURDEN AT SAMPLING POINT:
Feet: 22.5 Meters: 6.86

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 30

TOWNSHIP: 4 S

RANGE: 63 W

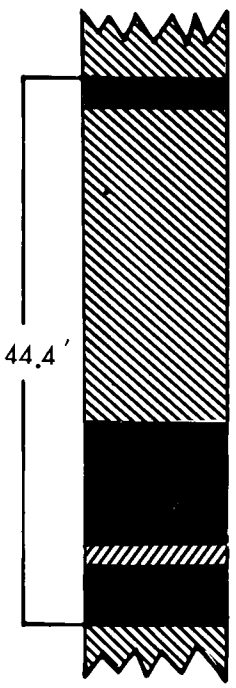
USGS TOPOGRAPHIC QUADRANGLE:
Strasburg NW 7.5' (1955)

DRILL HOLE: CE 463-30-2C

MINE TYPE: --

OPERATOR/OWNER: Cameron Engineers

LOWRY "B", BENNET "C" COAL BEDS



3'	COAL:	Sample No. CE 1. (Lowry "B")
24.5'	INTERBURDEN:	no core recovered
13.8'	COAL:	Sample Nos. CE 2-6, lignitic. (Bennet "C")
.7'	CLAY:	micaceous
2.4'	COAL:	Sample No. CE 7, lignitic.

SAMPLE NUMBER: CE 1

ANALYSES LABORATORY NUMBERS
USBM/DOE: --
USGS: --

APPARENT RANK OF COAL:
Subbituminous C

THICKNESS OF COAL:
Feet: 3.0 Meters: 0.9

THICKNESS SAMPLED:
Feet: 3.0 Meters: 0.9

TYPE OF SAMPLE: Drill Core: Coal

SAMPLE NUMBER: CE 2-6

ANALYSES LABORATORY NUMBERS
USBM/DOE: --
USGS: --

APPARENT RANK OF COAL:
Lignite A

THICKNESS OF COAL:
Feet: 13.8 Meters: 4.2

THICKNESS SAMPLED:
Feet: 13.8 Meters: 4.2

TYPE OF SAMPLE: Drill Core: Coal

SAMPLE NUMBER: CE 7

ANALYSES LABORATORY NUMBERS
USBM/DOE:
USGS:

APPARENT RANK OF COAL:
Lignite A

THICKNESS OF COAL:
Feet: 2.4 Meters: 0.73

THICKNESS SAMPLED:
Feet: 2.4 Meters: 0.73

TYPE OF SAMPLE: Drill Core: Coal

DENVER REGION
LOWRY FIELD

ARAPAHOE COUNTY

SAMPLE NUMBERS: CE 8-20

COAL BED NAME: Watkins or "E"

GEOLOGIC ROCK UNIT: Denver Fm

GEOLOGIC AGE: Paleocene

TOTAL SECTION MEASURED:
Feet: 24.7 Meters: 7.53

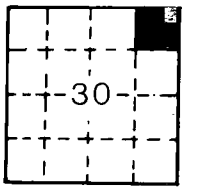
OVERBURDEN AT SAMPLING POINT:
Feet: 153.5 Meters: 46.8

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 30

TOWNSHIP: 4 S

RANGE: 63 W

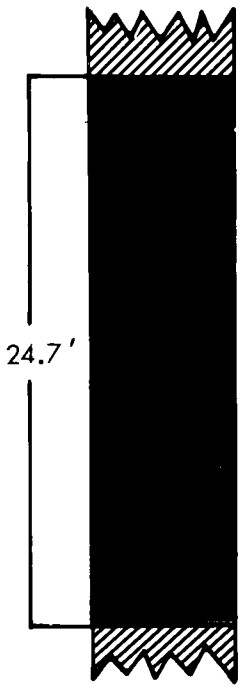
USGS TOPOGRAPHIC QUADRANGLE:
Strasburg NW 7.5' (1955)

DRILL HOLE: CE 463-30-2C

MINE TYPE: --

OPERATOR/OWNER: Cameron Engineers

WATKINS "E" COAL BED



COAL: Sample No. CE 8-20, lignitic.

ANALYSES LABORATORY NUMBERS
USBM/DOE: --
USGS: --

APPARENT RANK OF COAL:
Lignite A

THICKNESS OF COAL:
Feet: 24.7 Meters: 7.53

THICKNESS SAMPLED:
Feet: 24.7 Meters: 7.53

TYPE OF SAMPLE: Drill Core: Coal

DENVER REGION
STATION CREEK FIELD

ELBERT COUNTY

SAMPLE NUMBER: CE 21-25

COAL BED NAME: Kiowa B

GEOLOGIC ROCK UNIT: Denver Formation

GEOLOGIC AGE: Paleocene

TOTAL SECTION MEASURED:
Feet: 92.1 Meters: 28.1

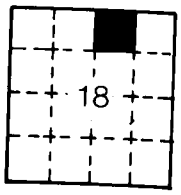
OVERBURDEN AT SAMPLING POINT:
Feet: 153 Meters: 46.6

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 18

TOWNSHIP: 9 S

RANGE: 61 W

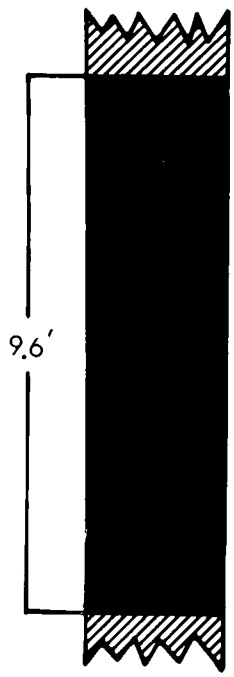
USGS TOPOGRAPHIC QUADRANGLE:
Big Gulch 7.5' (1970)

DRILL HOLE: CE 961-18-1C

MINE TYPE: --

OPERATOR/OWNER: Cameron Engineers

KIOWA B COAL BED



COAL: Sample No. CE 21-25, lignitic.

ANALYSES LABORATORY NUMBERS:
USBM/DOE: --
USGS: --

APPARENT RANK OF COAL:
Lignite A

THICKNESS OF COAL:
Feet: 9.6 Meters: 2.9

THICKNESS SAMPLED:
Feet: 9.6 Meters: 2.9

TYPE OF SAMPLE: Drill Core: Coal

DENVER REGION
STATION CREEK FIELD

ELBERT COUNTY

SAMPLE NUMBERS: CE 26-28,29-33

COAL BED NAME: Kiowa

GEOLOGIC ROCK UNIT: Denver Formation

GEOLOGIC AGE: Paleocene

TOTAL SECTION MEASURED:
Feet: 47.5 Meters: 14.5

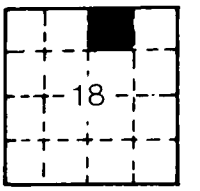
OVERBURDEN AT SAMPLING POINT:
Feet: 109 Meters: 33

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 18

TOWNSHIP: 9 S

RANGE: 61 W

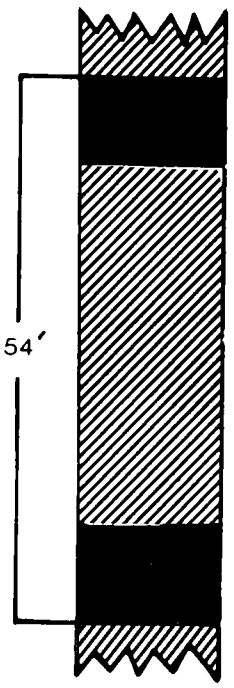
USGS TOPOGRAPHIC QUADRANGLE:
Big Gulch 7.5' (1970)

DRILL HOLE: CE 961-18-1C

MINE TYPE: --

OPERATOR/OWNER: Cameron Engineers

UPPER AND LOWER KIOWA COAL BEDS



9' COAL: Sample No. CE 26-28, lignitic.

35'

10.0' COAL: Sample No. CE 29-33, lignitic.

SAMPLE NUMBER: CE 26-28

ANALYSES LABORATORY NUMBERS:
USBM/DOE: --
USGS: --

APPARENT RANK OF COAL:
Lignite A

THICKNESS OF COAL:
Feet: 9 Meters: 2.7

THICKNESS SAMPLED:
Feet: 9 Meters: 2.7

TYPE OF SAMPLE: Drill Core: Coal

SAMPLE NUMBER: CE 29-33

ANALYSES LABORATORY NUMBERS
USBM/DOE: --
USGS: --

APPARENT RANK OF COAL:
Lignite A

THICKNESS OF COAL:
Feet: 10 Meters: 2.9

THICKNESS SAMPLED:
Feet: 10 Meters: 2.9

TYPE OF SAMPLE: Drill Core: Coal

DENVER REGION
STATION CREEK FIELD

ELBERT COUNTY

SAMPLE NUMBERS: CE 34-40

COAL BED NAME: Wolf

GEOLOGIC ROCK UNIT: Denver Fm

GEOLOGIC AGE: Paleocene

TOTAL SECTION MEASURED:
Feet: 20.3 Meters: 6.19

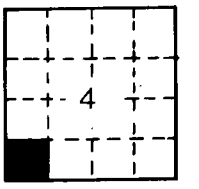
OVERBURDEN AT SAMPLING POINT:
Feet: 98 Meters: 30

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 4

TOWNSHIP: 8 S

RANGE: 62 W

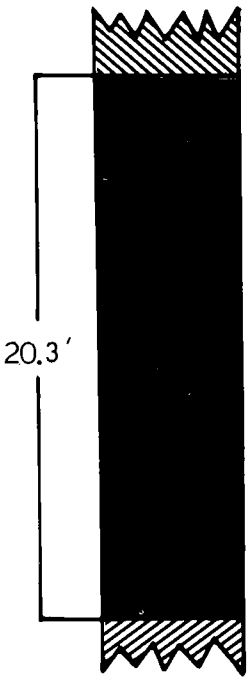
USGS TOPOGRAPHIC QUADRANGLE:
Kiowa NE 7.5' (1970)

DRILL HOLE: CE 862-4-1C

MINE TYPE: --

OPERATOR/OWNER: Cameron Engineers

WOLF COAL BED.



COAL: Sample No. CE 34-40, lignitic.

ANALYSES LABORATORY NUMBERS
USBM/DOE: --
USGS: --

APPARENT RANK OF COAL:
Lignite A

THICKNESS OF COAL:
Feet: 20.3 Meters: 6.19

THICKNESS SAMPLED:
Feet: 20.3 Meters: 6.19

TYPE OF SAMPLE: Drill Core: Coal

DENVER REGION
WATKINS FIELD

ADAMS COUNTY

SAMPLE NUMBER: CE 41-43;44-50,55;51

COAL BED NAME: Watkins "E"

GEOLOGIC ROCK UNIT: Denver Fm

GEOLOGIC AGE: Paleocene

TOTAL SECTION MEASURED:
Feet: 30 Meters: 9.1

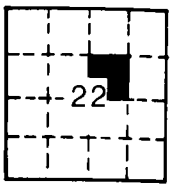
OVERBURDEN AT SAMPLING POINT:
Feet: 144.5-172 Meters: 44.1-52.4

STRIKE:

DIP:

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 22

TOWNSHIP: 3 S

RANGE: 65 W

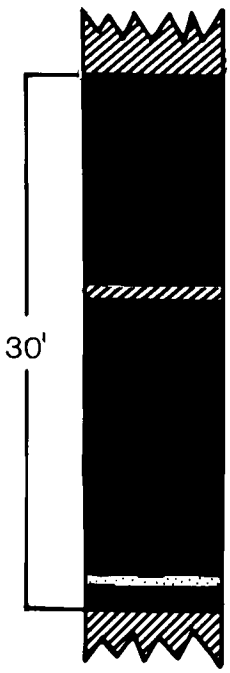
USGS TOPOGRAPHIC QUADRANGLE:
Box Elder School 7.5' (1966)

DRILL HOLE: CE 365-22-1C

MINE TYPE: --

OPERATOR/OWNER: Cameron Engineers

WATKINS "E" COAL BED



6.6' COAL: Sample No. CE 41-43, lignitic.

2.4' SHALE AND SANDSTONE

16.6' COAL: Sample No . CE 44-50, 55, lignitic.

1.9' SHALE AND SANDSTONE
2.5' COAL: Sample No. CE-51, lignitic.

SAMPLE NUMBER: CE 41-43

ANALYSES LABORATORY NUMBERS
USBM/DOE: --
USGS: --

APPARENT RANK OF COAL:
Lignite A

THICKNESS OF COAL:
Feet: 6.6 Meters: 2.0

THICKNESS SAMPLED:
Feet: 6.6 Meters: 2.0

TYPE OF SAMPLE: Drill Core: Coal

SAMPLE NUMBER : CE 44-50,55

ANALYSES LABORATORY NUMBERS:
USBM/DOE: --
USGS: --

APPARENT RANK OF COAL:
Lignite A

THICKNESS OF COAL:
Feet: 16.6' Meters: 5.06'

THICKNESS SAMPLED:
Feet: 16.6' Meters: 5.06'

TYPE OF SAMPLE: Drill Core: Coal

SAMPLE NUMBER: CE 51

ANALYSES LABORATORY NUMBERS
USBM/DOE: --
USGS: --

APPARENT RANK OF COAL:
Lignite A

THICKNESS OF COAL:
Feet: 2.5 Meters: .76

THICKNESS SAMPLED:
Feet: 2.5 Meters: .76

TYPE OF SAMPLE: Drill Core: Coal

DENVER REGION
WATKINS FIELD

ADAMS COUNTY

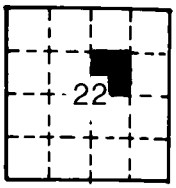
SAMPLE NUMBER: CE 52-54

COAL BED NAME: Uncorrelated (below Watkins or "E" seam)

GEOLOGIC ROCK UNIT: Denver Fm

GEOLOGIC AGE: Paleocene

LOCATION IN SECTION



SECTION: 22

TOWNSHIP: 3 S

RANGE: 65 W

TOTAL SECTION MEASURED:
Feet: 7.6 Meters: 2.3

OVERBURDEN AT SAMPLING POINT:
Feet: 253.9 Meters: 77.4

STRIKE:

DIP:

MAJOR CLEAT ORIENTATION IN COAL:
-- --

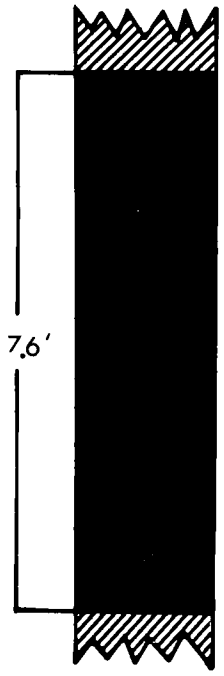
USGS TOPOGRAPHIC QUADRANGLE:
Box Elder School 7.5' (1966)

DRILL HOLE: CE 365-22-1C

MINE TYPE: --

OPERATOR/OWNER: Cameron Engineers

COAL BED NAME UNKNOWN



COAL: Sample No. CE 52-54, lignitic.

ANALYSES LABORATORY NUMBERS
USBM/DOE: --
USGS: --

APPARENT RANK OF COAL:
Lignite A

THICKNESS OF COAL:
Feet: 7.6 Meters: 2.3

THICKNESS SAMPLED:
Feet: 7.6 Meters: 2.3

TYPE OF SAMPLE: Drill Core: Coal

DENVER REGION
WATKINS-LOWRY FIELD

ARAPAHOE COUNTY

SAMPLE NUMBER: BS #1 Core 1, Core 2

COAL BED NAME: Watkins "E" Seam

GEOLOGIC ROCK UNIT: Denver Formation

GEOLOGIC AGE: Paleocene

TOTAL SECTION MEASURED:
Feet: 33 Meters: 10

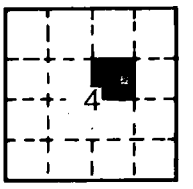
OVERBURDEN AT SAMPLING POINT:
Feet: 122 Meters: 32.2

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 4

TOWNSHIP: 4 S

RANGE: 64 W

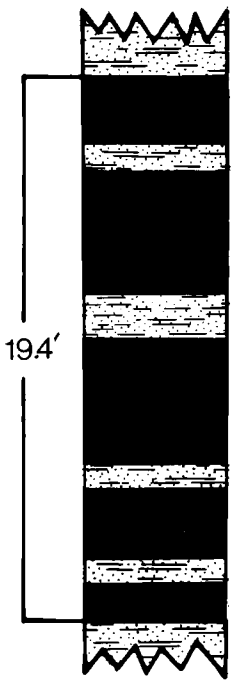
USGS TOPOGRAPHIC QUADRANGLE:
Watkins 7.5' (1954)

DRILL HOLE: BS #1

MINE TYPE: --

OPERATOR/OWNER: Mynet Inc.

WATKINS "E" COAL BED



CLAYSTONE: gray-brown, carbonaceous.

7.8' INTERBEDDED COAL AND CLAYSTONE: Sample No. BS #1 Core 1, brown to black, lignitic conchoidal fracture in seamlets 0.1' to 1.5' thick, interbedded with brown silty to sandy claystone.

11.6' INTERBEDDED COAL AND CLAYSTONE: Sample No. BS #1 Core 2, as above.

CLAYSTONE: dark brown.

ANALYSES LABORATORY NUMBERS
USBM/DOE: K94207
USGS: --

APPARENT RANK OF COAL:
Lignite A

THICKNESS OF COAL:
Feet: 7.1 Meters: 2.2

THICKNESS SAMPLED:
Feet: 7.1 Meters: 2.2

TYPE OF SAMPLE: Drill Core: Coal

DENVER REGION
WATKINS-LOWRY FIELD

SAMPLE NUMBER: BS #1 Core 2

ANALYSES LABORATORY NUMBERS:
USBM/DOE: K94208
USGS: --

APPARENT RANK OF COAL:
Lignite A

THICKNESS OF COAL:
Feet: 6.55 Meters: 2.0

THICKNESS SAMPLED:
Feet: 6.55 Meters: 2.0

TYPE OF SAMPLE: Drill Core: Coal

Table A1. Proximate and ultimate analyses, heat-of-combustion, forms-of-sulfur, free-swelling-index and ash-fusion-temperature determinations for seven coal samples from the Denver Region, Colorado.

[All analyses except heat-of-combustion, free-swelling index, and ash-fusion temperatures in percent. For each sample number, the analyses are reported three ways: first, as received; second, moisture free; and third, moisture and ash free. All analyses by Coal Analysis Section, U.S. Department of Energy, Pittsburgh, Pa. °F = (°C x 1.8) + 32; Kcal/kg = 0.556 (Btu/lb), L, less than the value shown]

	Proximate Analysis				Ultimate Analysis				
Sample number	Moisture	Volatile matter	Fixed carbon	Ash	Hydrogen	Carbon	Nitrogen	Oxygen	Sulfur
D194465	22.2	29.9	43.3	4.6	6.1	55.0	1.2	32.9	0.3
	---	38.4	55.7	5.9	4.7	70.7	1.5	16.9	.4
	---	40.8	59.2	---	5.0	75.1	1.6	18.0	.4
D194466	21.8	29.9	43.2	5.1	6.0	55.3	1.2	32.1	.3
	---	38.2	55.2	6.5	4.6	70.7	1.5	16.3	.4
	---	40.9	59.1	---	4.9	75.6	1.6	17.4	.4
D194467	21.5	29.7	43.6	5.2	6.1	56.1	1.2	31.0	.3
	---	37.8	55.5	6.6	4.7	71.5	1.5	15.1	.4
	---	40.5	59.5	---	5.1	76.5	1.6	16.2	.4
D221579	35.5	28.1	26.9	9.5	6.9	40.3	.9	42.1	.5
	---	43.6	41.7	14.7	4.6	62.5	1.4	16.3	.8
	---	51.1	48.9	---	5.4	73.3	1.6	19.2	.9
D221580	38.3	25.2	22.3	14.2	6.8	34.7	.9	43.2	.4
	---	40.8	36.1	23.0	4.1	56.2	1.5	14.8	.6
	---	53.1	46.9	---	5.4	73.1	1.9	19.3	.8
D221581	31.2	24.4	27.9	16.5	6.1	38.9	.9	37.3	.3
	---	35.5	40.6	24.0	3.8	56.5	1.3	13.9	.4
	---	46.7	53.3	---	5.0	74.4	1.7	18.3	.6
D221582	30.9	25.3	22.8	21.0	6.1	33.6	.7	38.2	.3
	---	36.6	33.0	30.4	3.9	48.6	1.0	15.5	.4
	---	52.6	47.4	---	5.5	69.9	1.5	22.3	.6

	Heat of Combustion			Forms of sulfur				Ash fusion temperature C		
Sample number	Kcal/kg	Btu/lb	Air-dried loss	Sulfate	Pyritic	Organic	Free swelling	Initial deformation	softening	fluid
D194465	5,260	9,460	10.6	0.01	0.05	0.21	B	1,205	1,230	1,260
	6,760	12,160	---	.01	.06	.27				
	7,180	12,920	---	.01	.07	.29				
D194466	5,270	9,480	10.0	.01L	.03	.26	B	1,145	1,160	1,175
	6,740	12,130	---	.01L	.04	.33				
	7,210	12,980	---	.01L	.04	.36				
D194467	5,310	9,570	9.7	.01L	.03	.24	B	1,155	1,170	1,190
	6,770	12,190	---	.01L	.04	.31				
	7,250	13,050	---	.01L	.04	.33				
D221579	3,840	6,910	30.6	.01L	.07	.38	B	1,155	1,215	1,280
	5,950	10,720	---	.01L	.11	.59				
	6,980	12,570	---	.01L	.13	.69				
D221580	3,290	5,930	34.2	.01L	.04	.33	B	1,265	1,325	1,370
	5,340	9,600	---	.01L	.06	.53				
	6,930	12,480	---	.01L	.08	.69				
D221581	3,650	6,560	26.5	.01L	.04	.24	B	1,175	1,240	1,305
	5,300	9,540	---	.01L	.06	.35				
	6,970	12,550	---	.01L	.08	.46				
D221582	3,200	5,750	25.6	.01L	.19	.13	B	1,540	1,540	1,540
	4,630	8,330	---	.01L	.27	.19				
	6,650	11,960	---	.01L	.40	.27				

Table A2. Major- and minor-oxide and trace element composition of the laboratory ash of seven coal and coal-associated rock samples from the Denver Region, Colorado.

[Values in percent or parts per million. Coal and shale ashed at 525°C. S after element title indicates determinations by semiquantitative emission spectrography. The spectrographic results are to be identified with geometric brackets whose boundaries are part of the ascending series 0.12, 0.18, 0.26, 0.38, 1.2, etc. but reported as midpoints of the brackets, 0.1, 0.15, 0.2, 0.3, 0.5, 0.7, 1.0, etc. Precision of the spectrographic data is plus-or-minus one bracket at 68 percent or plus-or-minus two brackets at 95 percent confidence level. L, less than the value shown; N, not detected].

Sample number	Ash (percent)	SiO2 (percent)	Al2O3 (percent)	CaO (percent)	MgO (percent)	Na2O (percent)	K2O (percent)	Fe2O3 (percent)	TiO2 (percent)	P2O5 (percent)
D194465	5.5	27	12	23	8.13	2.04	0.080	4.4	0.70	1.0L
D194466	5.2	33	11	18	7.79	3.19	.050	5.9	.90	1.0L
D194467	5.3	37	10	18	8.13	3.21	.030	5.5	.80	1.0L
D221579	12.6	32	17	21	2.49	.95	.22	5.3	.97	.79
D221580	25.2	51	25	7.7	1.36	1.21	.76	3.7	1.0	.40
D221581	14.2	43	16	15	1.82	2.23	.74	4.4	.99	.92
D221582	33.1	47	36	6.7	.66	.14L	.53	1.6	1.8	.69

Sample number	SO3 (percent)	B-S (ppm)	Ba-S (ppm)	Be-S (ppm)	Ce-S (ppm)	Cu (ppm)	Ga-S (ppm)	Ge-S (ppm)	La-S (ppm)	Li (ppm)
D194465	6.2	1,500	1,500	N	N	65	20	N	N	28
D194466	7.4	1,500	3,000	15	N	60	50	N	N	38
D194467	6.4	1,500	3,000	7	N	60	30	N	N	41
D221579	B	1,500	1,000	10	500L	47	20	20	50	66
D221580	B	700	1,500	7	100	55	30	5	70	96
D221581	B	1,500	3,000	10	100	31	30	5	70	74
D221582	B	100	700	2	500L	75	50	5	70	143

Sample number	La-S (ppm)	Li (ppm)	Mn (ppm)	Mo-S (ppm)	Nb-S (ppm)	Ni-S (ppm)	P (ppm)	Pb (ppm)	Sb (ppm)	Sc-S (ppm)
D194465	N	1.5	130	0.5	1L	0.7	240L	2.2	0.1	0.7
D194466	N	2.0	100	N	1L	1	230L	2.1	.1	.7
D194467	N	2.2	69	N	1L	1	230L	2.1	.1	.7
D221579	7	8.3	38	1.5	7	7	430	3.2L	.7	1.5
D221580	15	24	24	2	10	7	440	10	.9	5
D221581	10	11	24	.7	7	3	570	3.6L	.2	3
D221582	20	47	49	1	15	5	1,000	9.3	.2	5

Sample number	Se (ppm)	Sr-S (ppm)	Th (ppm)	U (ppm)	V-S (ppm)	Y-S (ppm)	Yb-S (ppm)	Zn (ppm)	Zr-S (ppm)	Sample number
D194465	1.0	100	0.6	0.6	5	1.5	0.1	1.2	7	D194465
D194466	.9	150	.7	.7	5	2	.15	1.4	7	D194466
D194467	1.0	150	.7	.8	5	3	.15	1.4	7	D194467
D221579	2.1	200	2.2	1.3	20	7	.7	4.4	70	D221579
D221580	3.0	200	4.8	1.9	50	15	1.5	22	100	D221580
D221581	1.4	500	1.9	.5	20	10	.7	7.1	70	D221581
D221582	3.8	300	6.6	1.9	70	15	1.5	16	150	D221582

Table A3. Content of nine trace elements in seven coal and coal-associated rock samples from the Denver Region, Colorado.

[Analyses on air-dried (32°C) coal and shale. L, less than the value shown]

Sample number	As (ppm)	Co (ppm)	Cr (ppm)	F (ppm)	Hg (ppm)	Sb (ppm)	Se (ppm)	Th (ppm)	U (ppm)
D194465	0.4	0.4	2.1	20L	0.02	0.1	1.0	0.6	0.6
D194466	.4	.4	2.6	20L	.01	.1	.9	.7	.7
D194467	.4	.5	2.7	20L	.01	.1	1.0	.7	.8
D221579	1.6	1.2	3.8	35	.04	.7	2.1	2.2	1.3
D221580	1.7	2.1	15	140	.08	.9	3.0	4.8	1.9
D221581	1.3	1.2	4.7	45	.03	.2	1.4	1.9	.5
D221582	.9	2.9	5.9	130	.11	.2	3.8	6.6	1.9

Table A4. Major-, minor- and trace-element composition of seven coal and coal-associated rock samples from the Denver Region, Colorado.

[Values in percent or parts per million. As, Co, Cr, F, Hg, Sb, Se, Th, and U values are from direct determinations on air-dried (32°C) coal and shale; all other values calculated from analyses of ash. S means analysis by emission spectrography; L, less than the value shown; N, not detected].

Sample number	Si (percent)	Al (percent)	Ca (percent)	Mg (percent)	Na (percent)	K (percent)	Fe (percent)	Ti (percent)	As (ppm)	B-S (ppm)
D194465	0.69	0.35	0.90	0.27	0.083	0.004	0.17	0.023	0.4	70
D194466	.80	.30	.67	.24	.12	.002	.21	.028	.4	70
D194467	.92	.28	.68	.26	.13	.001	.20	.025	.4	70
D221579	1.9	1.1	1.9	.19	.089	.023	.47	.073	1.6	150
D221580	6.0	3.3	1.4	.21	.23	.16	.66	.16	1.7	150
D221581	2.8	1.2	1.6	.16	.23	.088	.44	.084	1.3	200
D221582	7.3	6.3	1.6	.13	.034L	.15	.36	.36	.9	30

Sample number	Ba-S (ppm)	Be-S (ppm)	Ce-S (ppm)	Co (ppm)	Cr (ppm)	Cu (ppm)	F (ppm)	Ga-S (ppm)	Ge-S (ppm)	Hg (ppm)	Mn (ppm)
D194465	70	N	N	0.4	2.1	3.6	20L	1	N	0.02	2,340
D194466	150	.7	N	.4	2.6	3.1	20L	2	N	.01	1,940
D194467	150	.3	N	.5	2.7	3.2	20L	1.5	N	.01	1,310
D221579	150	1	70L	1.2	3.8	5.9	35	2	3	.04	303
D221580	300	1.5	20	2.1	15	14	140	7	1.5	.08	97
D221581	500	1.5	15	1.2	4.7	4.4	45	5	.7	.03	171
D221582	200	1	150L	2.9	5.9	25	30	5			148

Sample number	Mo-S (ppm)	Nb-S (ppm)	Ni-S (ppm)	Pb (ppm)	Sc-S (ppm)	Sr-S (ppm)	V-S (ppm)	Y-S (ppm)	Yb-S (ppm)	Zn (ppm)	Zr-S (ppm)
D194465	10	20L	15	40	15	2,000	70	30	2	22	150
D194466	N	20L	20	40	15	3,000	100	50	3	26	150
D194467	N	20L	20	40	15	3,000	100	50	3	26	150
D221579	10	50	50	25L	15	2,000	150	70	5	35	500
D221580	7	50	30	41	15	1,000	200	50	5	88	500
D221581	5	50	20	25L	20	3,000	150	70	7	50	500
D221582	3	50	15	28	15	1,000	200	30	3	48	300

Table A5. Arithmetic mean, observed range, geometric mean, and geometric deviation of proximate and ultimate analyses, heat of combustion, forms of sulfur, and ash-fusion temperatures of seven coal samples from the Denver Region, Colorado.

[All values are in percent except Kcal/kg, Btu/lb, ash-fusion temperatures, and geometric deviation and are reported on the as-received basis. °F = (C° x 1.8) + 32; Kcal/kg = 0.556 (Btu/lb)]

	Arithmetic mean	Observed range		Geometric mean	Geometric deviation
		Minimum	Maximum		
Proximate and Ultimate Analyses					
Moisture	28.9	21.5	38.3	28.0	1.3
Volatile Matter	27.5	24.4	29.9	27.4	1.1
Fixed Carbon	33.1	22.3	43.6	31.6	1.4
Ash	11.2	4.6	21.09	9.2	1.9
Hydrogen	6.3	6.0	6.9	6.3	1.1
Carbon	45.0	33.6	56.1	43.9	1.3
Nitrogen	1.0	.7	1.2	1.0	1.2
Oxygen	36.7	31	43.2	36.4	1.1
Sulfur	.3	.3	.5	.3	1.2
Heat of combustion					
Kcal/kg	4,280	3,200	5,320	4,165	1.3
Btu/lb	7,695	5,755	9,565	7,495	1.3
Forms of sulfur					
Sulfate	0.01	0.01	0.01	0.01	1.0
Pyritic	.06	.03	.19	.05	1.9
Organic	.26	.13	.38	.24	1.4
Ash-fusion temperatures, °C					
Initial deformation	1,235	1,145	1,535	1,225	1.1
Softening temperature	1,270	1,160	1,535	1,260	1.1
Fluid temperature	1,305	1,175	1,535	1,300	1.1

Table A6. Arithmetic mean, observed range, geometric mean, and geometric deviation of ash content and contents of ten major and minor oxides in the laboratory ash of seven coal samples from the Denver Region, Colorado.

[All samples were ashed at 525°C; all analyses except geometric deviation are in percent; L, less than the value shown]

Oxide	Arithmetic mean	Observed range		Geometric mean	Geometric deviation
		Minimum	Maximum		
(Ash)	15.0	5.2	33.1	11.0	2.2
SiO_2	39	27	51	38	1.3
Al_2O_3	18	10	36	16	1.6
CaO	16	6.7	23	14	1.6
MgO	4.9	.66	8.3	3.1	2.7
Na_2O	2.0	.14	3.2	1.7	1.8
K_2O	.42	.03	.76	.19	3.8
Fe_2O_3	4.5	1.6	5.9	4.1	1.6
TiO_2	1.1	.7	1.8	.99	1.3
SO_3	6.7	6.2	7.4	6.6	1.1

Table A7. Arithmetic mean, observed range, geometric mean, and geometric deviation of 36 elements in seven coal samples from the Denver Region, Colorado.

[All analyses are in percent or parts per million and are reported on a whole-coal basis. As, F, Hg, Sb, Se, Th, and U values used to calculate the statistics were determined directly on whole coal. All other values used were calculated from determinations made on coal ash. L, less than the value shown]

Element	Arithmetic mean	Observed Range		Geometric mean	Geometric deviation
		Minimum	Maximum		
		Percent			
Si	3.1	0.69	7.3	2.0	2.6
Al	2.0	.28	6.3	1.0	3.4
Ca	1.3	.67	1.9	1.2	1.5
Mg	.21	.13	.27	.20	1.3
Na	.14	.034L	.23	.12	1.7
K	.10	.001	.16	.017	7.9
Fe	.37	.17	.66	.32	1.7
Ti	.11	.023	.36	.067	2.8
		Parts per million			
As	1.0	0.4	1.7	0.8	2.0
B	100	30	200	100	1.9
Ba	200	70	500	200	1.9
Be	1	.3	1.5	.7	2.2
Ce	13	15	20	12.4	1.3
Cu	8.4	3.1	25	6.1	2.2
F	61	20L	140	39	2.7
Ga	5	1	7	3	2.6
Ge	1	.7	3	.7	2.5
Hg	.04	.01	.08	.03	2.6
Li	15	1.5	47	6.8	3.8
Mn	64	24	130	52	1.9
Mo	1	.5	2	.7	2.1
Nb	7	1	15	7	1.6
Ni	5	.7	7	2	2.7
P	620	230L	1,000	570	1.5
Pb	4.2	2.1	10	2.7	2.6
Sb	.3	.1	.9	.2	2.6
Sc	2	.7	5	1.5	2.5
Se	1.9	.9	3.8	1.6	1.8
Sr	200	100	500	200	1.7
Th	2.6	.55	6.6	1.7	2.7
U	1.1	.5	1.9	.9	1.7
V	27	5	70	15	3.1
Y	10	1.5	15	5	2.6
Yb	.8	.1	1.5	.5	3.2
Zn	8.4	1.2	22	4.2	3.4
Zr	90	7	150	30	4.1

Table A8. Proximate and ultimate analyses, and heat-of-combustion determinations of 12 coal samples from the Denver region. [All analyses except heat-of-combustion are in percent. Basis represents the form of analyses: 1, as received; 2, moisture free; 3, moisture and ash free.]

Sample #	Lab #	Basis	Moisture	Volatile Matter	Fixed Carbon	Ash	H	C	N	O	S	Heat Value Btu/lb	Heat Value Kcal/Kg
LOWRY AREA													
DH 463-30-2C													
CE 1		1	2.7	32.2	31.5	9.4					0.4	7813	4341
		2		44	43.2	12.8					0.5	10703	5946
CE 2-6		1	27.7-37.8	22.9-27.9	16.9-26.6	7.7-32.1					0.3-0.5	4397-6800	2443-3778
		2		31.7-44.9	23.9-42.8	12.3-44.4					0.4-0.8	6077-10933	3376-6074
CE 7		1	34.9	27.0	23.5	14.6					0.5	6356	3531
		2		41.5	36.1	22.4					0.8	9761	5223
CE 8-20		1	19.0-36.6	18.6-26.1	12.5-25.5	11.8-43.7					0.1-0.9	2936-6463	1631-3591
		2		24.8-41.1	16.7-40.3	18.6-58.5					0.2-1.3	3296-10198	2181-5666
WATKINS-LOWRY AREA													
BS #1													
Core 1	K94207	1	21.0	41.4	7.1	30.5	4.9	34.2	0.7	29.5	0.3	5636	3131
		2		52.4	9.0	38.6	3.2	43.3	0.8	13.7	0.4	7136	3964
		3		85.3	14.7		5.2	70.5	1.4	22.3	0.6	11627	6459
Core 2	K94208	1	27.4	26.4	16.6	29.6	5.0	30.3	0.6	34.0	0.4	5102	2834
		2		36.4	22.8	40.8	2.8	41.8	0.9	13.0	0.6	7029	3905
		3		61.6	38.4		4.7	70.6	1.4	22.4	1.0	11877	6598
STATION CREEK AREA													
961-18-1C													
CE 21-25		1	26.0-45.7	17.3-25.3	14.5-28.6	6.9-36.0					0.3-1.3	3749-6728	2083-3738
		2		29.8-42.7	21.5-46.2	11.1-48.7					0.4-1.9	5611-10883	3117-6046
CE 26-28		1	22.9-30.2	18.7-22.1	11.2-19.2	28.8-47.2					0.1-0.4	2551-4570	1417-2539
		2		24.3-31.3	14.5-27.4	41.2-61.3					0.2-0.5	3311-6544	1839-3636
CE 29-33		1	26.4-39.6	18.2-25.6	10.9-26.9	9.8-44.6					0.3-0.4	2659-6301	1477-3501
		2		24.7-42.0	14.8-42.0	16.3-60.6					0.4-0.7	3611-10129	2006-5627
862-4-1C													
CE-34-40		1	30.2-38.7	19.3-26.1	14.9-24.3	10.9-35.6					0.2-0.3	3636-6189	2020-3438
		2		27.7-42.5	21.3-39.7	17.8-51.0					0.3-0.5	5209-10096	2894-5609
WATKINS AREA													
365-22-1C													
CE 41-51,55		1	21.4-36.6	16.3-26.8	10.8-26.9	10.2-44.5					0.1-0.3	2693-6526	1496-3626
		2		24.1-41.4	14.8-42.5	16.1-61.1					0.1-0.5	3696-10299	2053-5722
CE 52-54		1	24.9-29.3	20.9-23.3	16.4-18.4	30.3-37.7					0.2-0.4	4082-4835	2268-2686
		2		20.9-23.3	16.4-18.4	42.4-50.2					0.3-0.5	5438-5687	3021-3715

Section B
Chemical Analyses of Coal Samples from the
Green River Region

Figure B1. Coal fired power plant at Craig, Colorado.

Green River Region

The Colorado portion of the Green River Region lies in the northwest corner of the state, predominantly in Moffat and Routt Counties (see figure B2). The region extends north into Wyoming where major coal fields also exist. The basin consists of a broad southeast trending syncline with locally steeply-dipping beds on the basin margin and typically near-horizontal beds towards the center of the structure (Landis, 1959). The region is bound on the southeast margin by the axial basin uplift and the Williams Fork Mountains. Coal beds of the region are found in the Cretaceous Iles, Williams Fork, and Lance Formations and in the Paleocene Fort Union Formation (see figure B3).

Information regarding 31 coal and associated rock samples collected in the Green River Region are contained in this section. Of these 24 are coal samples and 7 are rock samples. These samples were collected from 2 mines and 6 drill holes, all in the Yampa field. Ten coal samples from the Hayden Gulch and C-1C-H drill holes were not analyzed for trace element and these proximate and ultimate analyses are tabulated separately at the end of this section. Tables of statistics, including arithmetic mean, observed range, geometric mean, and geometric deviation, are provided in tables B5 through B7 for the laboratory analytical data of the other 14 coal and 7 rock samples which have complete analyses (including trace element). The apparent rank of the coal samples has been calculated using the Parr formula.

For these samples the apparent rank ranges from subbituminous B to high-volatile B bituminous. The as-received sulfur values range from 0.4 to 0.9 percent with the expected value or geometric mean at 0.5 percent.

The Yampa field is the only coal field in the Colorado portion of the Green River Region. Historically, there are 192 coal mines of record in the Yampa field which have produced over 100 million tons of coal (Boreck and Murray, 1979). In 1979 alone, the Green River Region coal production exceeded 10 million tons from 13 mines, over half of the entire state production of about 18 million tons for the same period from 57 mines (Colorado Divison of Mines, 1980). According to Boreck and Murray (1979), the remaining demonstrated reserve base of coal in the Green River Region is over six and a half billion tons.

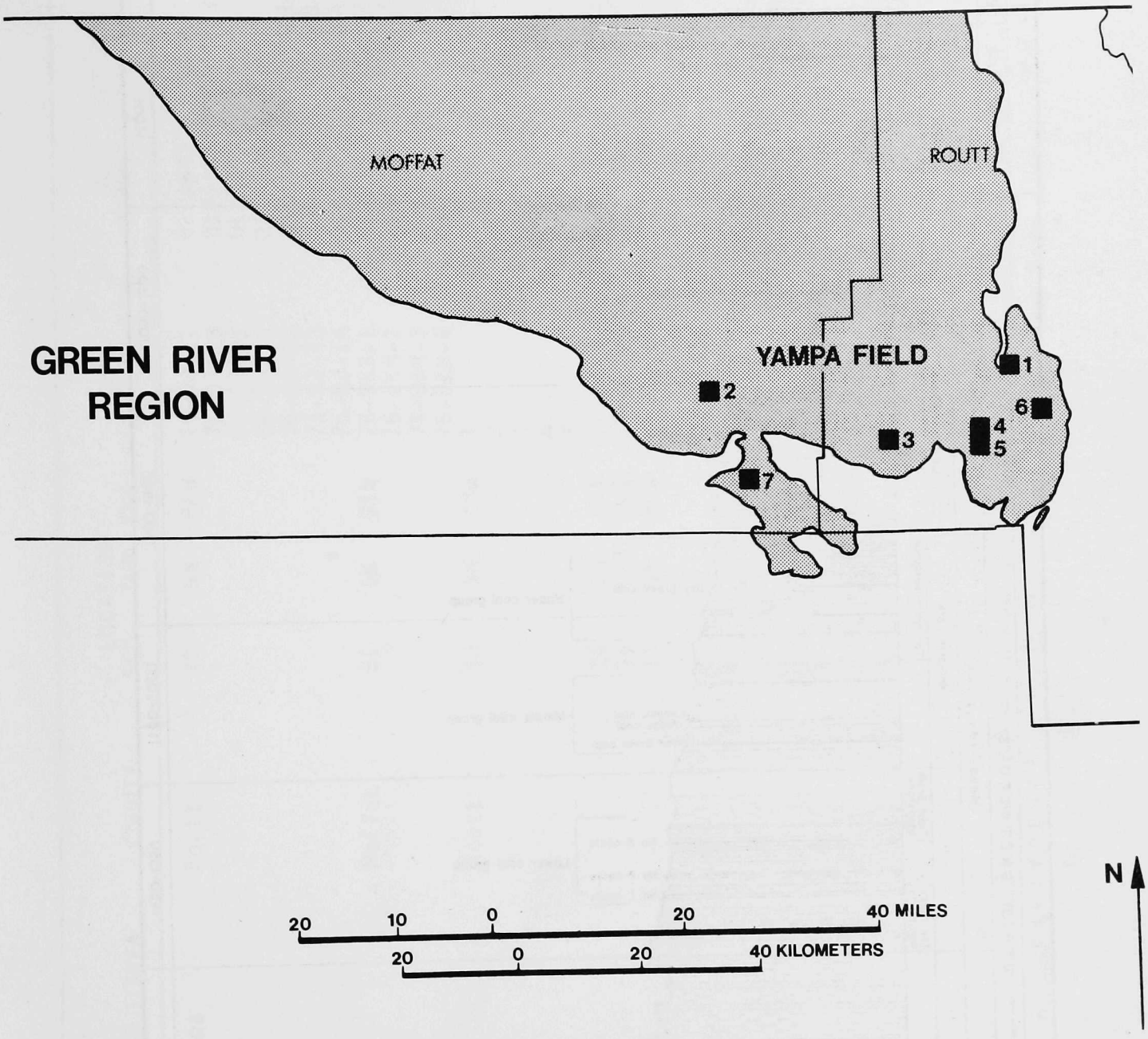


Figure B2. Location of samples within the Green River Region.

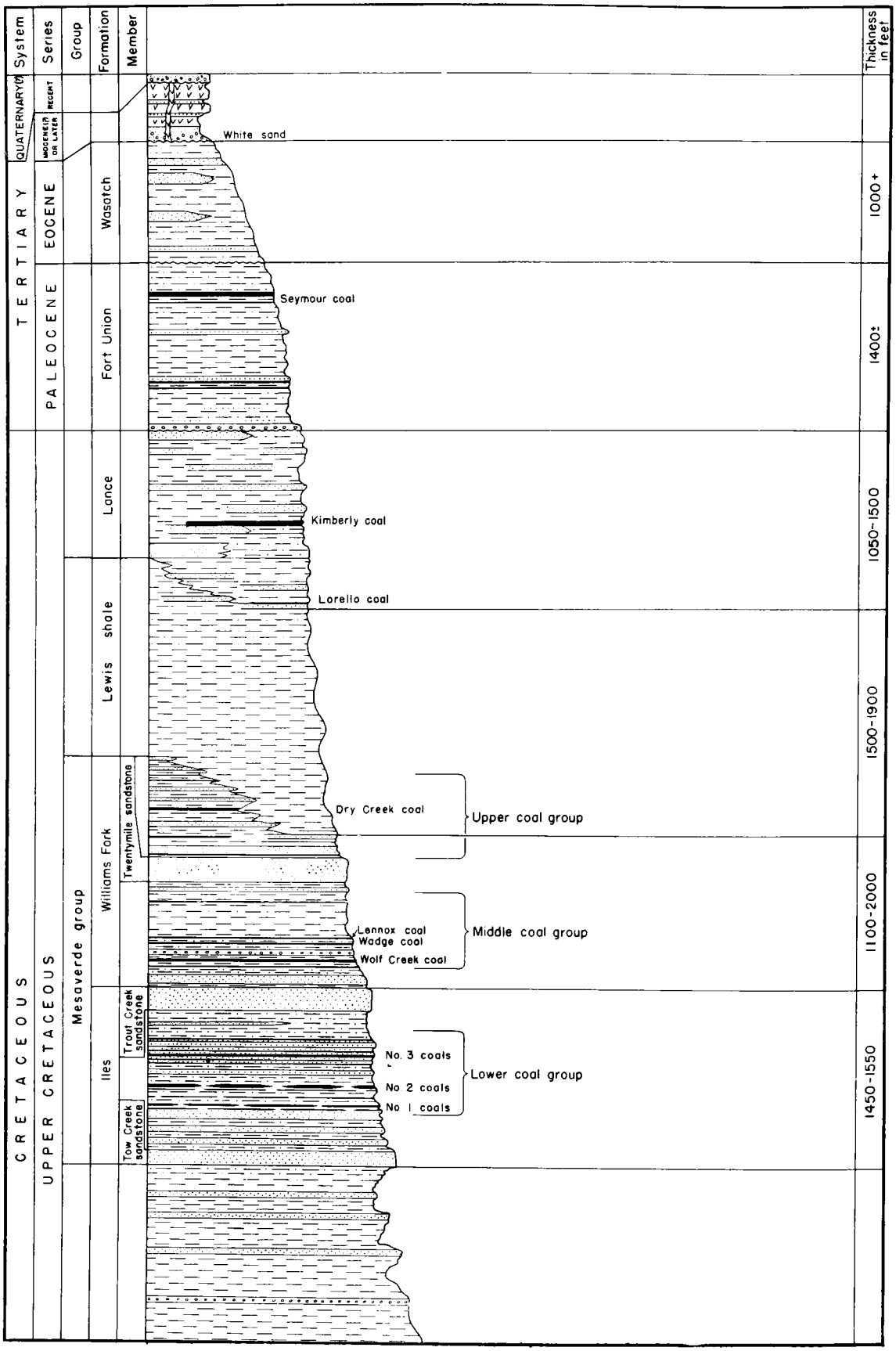


Figure B3. Generalized stratigraphic section of coal-bearing rocks in the Green River Region. Coal beds shown in black (from Bass and others, 1955).

MAP INDEX #	FIELD/AREA	COUNTY	LOCATION SEC.	TWP.	RGE.	CGS SAMPLE #	USGS SAMPLE #	US DOE SAMPLE #	SAMPLE TYPE
1	Yampa	Routt	20	6N	86W	76-DJ-21	D184642	K69862	Channel
						76-DJ-22	D184643	K69862	Floor
						76-DJ-23	D188240		Floor
						76-DJ-10	D188239		Floor
						76-DJ-12	D184639	K69861	Channel
						76-DJ-13	D184640	K69861	Channel
						76-DJ-14	D184641	K69861	Channel
2		Moffat	31	6N	91W	76-DKM-1	D188255	K72357	Channel
						76-DKM-2	D188256	K72357	Channel
						76-DKM-3	D188245		Floor
						76-DKM-4	D188246		Channel
3		Routt	30	5N	88W	1			Core
						2			Core
						3			Core
						4			Core
						5			Core
4			26	5N	87W	76-DJ-27	D184646	K69865	Core
5			35	5N	87W	76-DJ-26	D184645	K69864	Core
6			13	5N	86W	76-DB-13	D188236		Core
						76-DB-14	D188252	K72355	Core
						76-DB-15	D188237		Core
						76-DB-17	D188238		Core
						76-DB-16	D188254	K72356	Core
						76-DB-12	D188253	K72356	Core
7			13	5N	86W	76-DJ-28	D188250	K72353	Core
						76-DJ-29	D188251	K72354	Core
8		Moffat	23	4N	91W	C-1C-H Run 1		K89040	Core
						Run 19		K89077	Core
						Run 28		K89078	Core
						Run 36		K89079	Core
						Run 41		K89080	Core

Figure B4. Sample index for the Green River Region. (Map index number refers to figure B2.)

GREEN RIVER REGION
YAMPA FIELD

ROUTT COUNTY

SAMPLE NUMBERS: 76-DJ-21,22,23

COAL BED NAME: Wadge

GEOLOGIC ROCK UNIT: Mesaverde Group

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: 8.2 Meters: 2.5

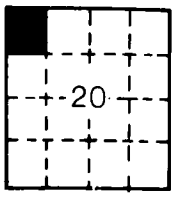
OVERBURDEN AT SAMPLING POINT:
Feet: 30-40 Meters: 9-13

STRIKE: N 73°E

DIP: 10°NW

MAJOR CLEAT ORIENTATION IN COAL:
Face: N 48-60°W, 48-60°NE
Butt: N 5-18°W

LOCATION IN SECTION



SECTION: 20

TOWNSHIP: 6 N

RANGE: 86 W

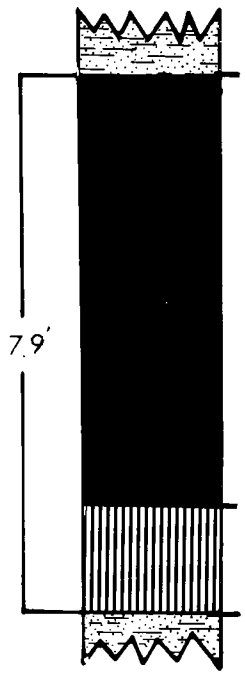
USGS TOPOGRAPHIC QUADRANGLE:
Milner 7.5' (1971)

MINE NAME: Denton Strip Mine

MINE TYPE: Surface

OPERATOR/OWNER: Northern Coal Co.

WADGE COAL BED



SANDY CLAYSTONE: brown.

5.9' COAL: Sample No. 76-DJ-21, banded, vitrain in dull to bright attritus, 8" vitrain band 4.5' from top of bed, trace pyrite.

2.0' SHALY COAL: Sample No. 76-DJ-22, few 1" sandstone lenses, gray, fine-grained.

SILTY SANDSTONE: Sample No. 76-DJ-23, brown, very hard.

SAMPLE NUMBER: 76-DJ-21

ANALYSES LABORATORY NUMBERS
USBM/DOE: K69862
USGS: D184642

APPARENT RANK OF COAL:
Subbituminous A

THICKNESS OF COAL:
Feet: 7.9 Meters: 2.4

THICKNESS SAMPLED:
Feet: 5.9 Meters: 1.7

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: 76-DJ-22

ANALYSES LABORATORY NUMBERS
USBM/DOE: K69862
USGS: D184643

APPARENT RANK OF COAL:

THICKNESS OF COAL:
Feet: 7.9 Meters: 2.4

THICKNESS SAMPLED:
Feet: 2.0 Meters: 0.61

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: 76-DJ-23

ANALYSES LABORATORY NUMBERS
USBM/DOE: --
USGS: D188240

APPARENT RANK OF COAL:

THICKNESS OF COAL:
Feet: -- Meters: --

THICKNESS SAMPLED:
Feet: 0.3 Meters: 0.1

TYPE OF SAMPLE: Floor rock

GREEN RIVER REGION
YAMPA FIELD

ROUTT COUNTY

SAMPLE NUMBERS: 76-DJ-10,12,13,14

COAL BED NAME: Wadge

GEOLOGIC ROCK UNIT: Mesaverde Group

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: 9.1 Meters: 2.8

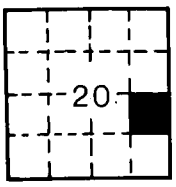
OVERBURDEN AT SAMPLING POINT:
Feet: 30-40 Meters: 9-13

STRIKE: N 72°E

DIP: 10°NW

MAJOR CLEAT ORIENTATION IN COAL:
Face: N 46-60°W, 48-60°NE
Butt: N 5-18°W

LOCATION IN SECTION



SECTION: 20

TOWNSHIP: 6 N

RANGE: 86 W

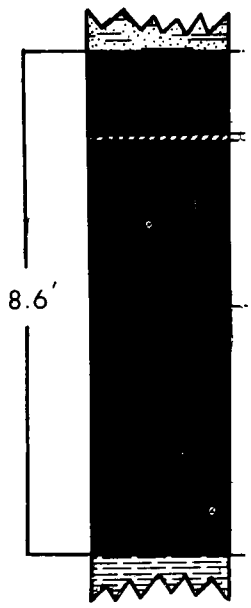
USGS TOPOGRAPHIC QUADRANGLE:
Milner 7.5' (1971)

MINE NAME: Denton Strip Mine

MINE TYPE: Surface

OPERATOR/OWNER: Northern Coal Co.

WADGE COAL BED



SANDY CLAYSTONE: brown.

1.8' COAL: Sample No. 76-DJ-12, dull to bright attritus, traces of gypsum and pyrite.

0.02' PARTING

3.0' COAL: Sample No. 76-DJ-13, banded, moderate medium vitrain in dull to bright attritus.

3.78' COAL: Sample No. 76-DJ-14, banded, moderate to sparse vitrain in dull to bright attritus (decreasing towards lower contact), pyrite present.

CLAYSTONE: Sample No. 76-DJ-10, gray to black, few thin coal bands.

SAMPLE NUMBER: 76-DJ-10

ANALYSES LABORATORY NUMBERS
USBM/DOE: --
USGS: D188239

APPARENT RANK OF COAL:

THICKNESS OF COAL:
Feet: -- Meters: --

THICKNESS SAMPLED:
Feet: 0.5 Meters: 0.15

TYPE OF SAMPLE: Floor rock

SAMPLE NUMBER: 76-DJ-12

ANALYSES LABORATORY NUMBERS
USBM/DOE: K69861
USGS: D184639

APPARENT RANK OF COAL:
High-volatile C bituminous

THICKNESS OF COAL:
Feet: 8.6 Meters: 2.6

THICKNESS SAMPLED:
Feet: 1.8 Meters: 0.54

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: 76-DJ-13

ANALYSES LABORATORY NUMBERS
USBM/DOE: K69861
USGS: D184640

APPARENT RANK OF COAL:
High-volatile C bituminous

THICKNESS OF COAL:
Feet: 8.6 Meters: 2.6

THICKNESS SAMPLED:
Feet: 3.0 Meters: 0.9

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: 76-DJ-14

ANALYSES LABORATORY NUMBERS
USBM/DOE: K69861
USGS: D184641

APPARENT RANK OF COAL:
High-volatile C bituminous

THICKNESS OF COAL:
Feet: 8.6 Meters: 2.6

THICKNESS SAMPLED:
Feet: 3.78 Meters: 1.14

TYPE OF SAMPLE: Coal-channel

GREEN RIVER REGION
YAMPA FIELD

MOFFAT COUNTY

SAMPLE NUMBERS: 76-DKM-1,2,3,4

COAL BED NAME: "F"

GEOLOGIC ROCK UNIT: Williams Fork Fm

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: 6.0 Meters: 1.8

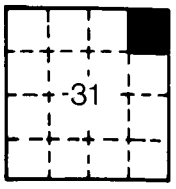
OVERBURDEN AT SAMPLING POINT:
Feet: 300-650 Meters: 90-200

STRIKE: NW

DIP: 12-15°NE

MAJOR CLEAT ORIENTATION IN COAL:
N 40-46°W, 13-20°NE

LOCATION IN SECTION



SECTION: 31

TOWNSHIP: 6 N

RANGE: 91 W

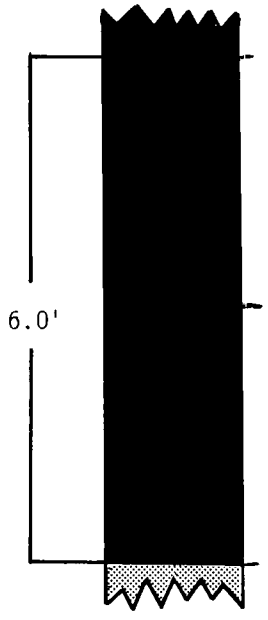
USGS TOPOGRAPHIC QUADRANGLE:
Round Bottom 7.5' (1966)

MINE NAME: Eagle No. 5

MINE TYPE: Underground

OPERATOR/OWNER: Empire Energy Corp.

"F" COAL BED



3-4' COAL: Not sampled.

3.0' COAL: Sample No. 76-DKM-1, banded, vitrain and fusain in dull to bright attritus, blocky.

3.0' COAL: Sample No. 76-DKM-2, as above.

CLAYSTONE: Sample No. 76-DKM-3, dark brown, hard.

INTERLAMINATED SANDSTONE, SILTSTONE: Sample No. 76-DKM-4.

SAMPLE NUMBER: 76-DKM-1

ANALYSES LABORATORY NUMBERS
USBM/DOE: K72357
USGS: D188255

APPARENT RANK OF COAL:
High-volatile B bituminous

THICKNESS OF COAL:
Feet: 9-10 Meters: 2.7-3.1

THICKNESS SAMPLED:
Feet: 3.0 Meters: 0.9

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: 76-DKM-2

ANALYSES LABORATORY NUMBERS
USBM/DOE: K72357
USGS: D188256

APPARENT RANK OF COAL:
High-volatile B bituminous

THICKNESS OF COAL:
Feet: 9-10 Meters: 2.7-3.1

THICKNESS SAMPLED:
Feet: 3.0 Meters: 0.9

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: 76-DKM-3

ANALYSES LABORATORY NUMBERS
USBM/DOE: --
USGS: D188245

APPARENT RANK OF COAL:

THICKNESS OF COAL:
Feet: -- Meters: --

THICKNESS SAMPLED:
Feet: -- Meters: --

TYPE OF SAMPLE: Floor

SAMPLE NUMBER: 76-DKM-4

ANALYSES LABORATORY NUMBERS
USBM/DOE: --
USGS: D188246

APPARENT RANK OF COAL:

THICKNESS OF COAL:
Feet: -- Meters: --

THICKNESS SAMPLED:
Feet: -- Meters: --

TYPE OF SAMPLE: Rock

GREEN RIVER REGION
YAMPA FIELD

ROUTT COUNTY

SAMPLE NUMBER: --

COAL BED NAME: Nos. 1,2,3,4,5

GEOLOGIC ROCK UNIT: Williams Fork Fm.

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: 92 Meters: 28

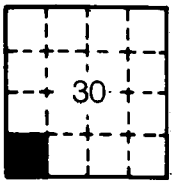
OVERBURDEN AT SAMPLING POINT:
Feet: 50 Meters: 15

STRIKE: --

DIP: 6° NE

MAJOR CLEAT ORIENTATION IN COAL:
--

LOCATION IN SECTION



SECTION: 30

TOWNSHIP: 5 N

RANGE: 88 W

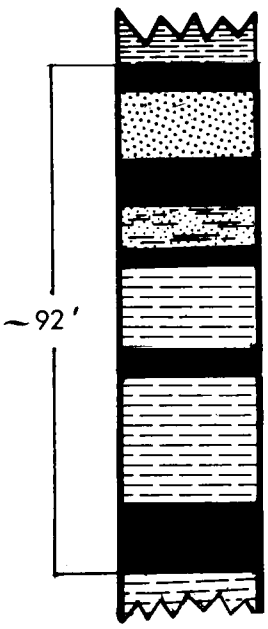
USGS TOPOGRAPHIC QUADRANGLE:
Hayden Gulch 7.5' (1971)

MINE NAME: Hayden Gulch

MINE TYPE: Surface

OPERATOR/OWNER: H-G Coal Co.

1,2,3,4,5 COAL BEDS



50'	SHALE: dark gray, hard.
2.8'	COAL BED NO. 1
14'	SILTSTONE: gray, interbedded with shale and sandstone.
6.8'	COAL BED NO. 2
12'	SHALE: gray, interbedded with sandstone.
1.4'	COAL BED NO. 3
17'	INTERBEDDED SHALE AND SILTSTONE: gray, some sandstone.
4.5'	COAL BED NO. 4
2.7'	SHALE: gray, some sandstone, some thin siltstone beds.
6.2'	COAL BED NO. 5
	SHALE: dark gray to black carbonaceous.

COAL BED NAME: No. 1

LABORATORY ANALYSES:
Commercial Testing & Engineering Co.

APPARENT RANK OF COAL:
Subbituminous B

THICKNESS OF COAL:
Feet: 1.5-3.9 Meters: 0.5-1.2

THICKNESS SAMPLED:
Feet: 2.8 Meters: 0.85

TYPE OF SAMPLE: Drill Core: Coal

COAL BED NAME: No. 2

LABORATORY ANALYSES:
Commercial Testing & Engineering Co.

APPARENT RANK OF COAL:
Subbituminous B

THICKNESS OF COAL:
Feet: 5.7-8.8 Meters: 1.7-2.7

THICKNESS SAMPLED:
Feet: 6.8 Meters: 2.1

TYPE OF SAMPLE: Drill Core: Coal

COAL BED NAME: No. 3

LABORATORY ANALYSES:
Commercial Testing & Engineering Co.

APPARENT RANK OF COAL:
Subbituminous B

THICKNESS OF COAL:
Feet: 1.2-2.3 Meters: 0.36-0.70

THICKNESS SAMPLED:
Feet: 1.4 Meters: 0.43

TYPE OF SAMPLE: Drill Core: Coal

COAL BED NAME: No. 4

LABORATORY ANALYSES:
Commercial Testing & Engineering

APPARENT RANK OF COAL:
Subbituminous B

THICKNESS OF COAL:
Feet: 3.4-5.1 Meters: 1.0-1.6

THICKNESS SAMPLED:
Feet: 4.5 Meters: 1.4

TYPE OF SAMPLE: Drill Core: Coal

COAL BED NAME: No. 5

LABORATORY ANALYSES:
Commercial Testing & Engineering Co.

APPARENT RANK OF COAL:
Subbituminous B

THICKNESS OF COAL:
Feet: 4.8-10.0 Meters: 1.5-3.1

THICKNESS SAMPLED:
Feet: 6.2 Meters: 1.9

TYPE OF SAMPLE: Drill Core: Coal

GREEN RIVER REGION
YAMPA FIELD

ROUTT COUNTY

SAMPLE NUMBER: 76-DJ-27

COAL BED NAME: Wadge

GEOLOGIC ROCK UNIT: Williams Fork Fm

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: 10 Meters: 3.1

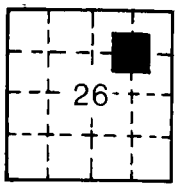
OVERBURDEN AT SAMPLING POINT:
Feet: 1393 Meters: 424.7

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 26

TOWNSHIP: 5 N

RANGE: 87 W

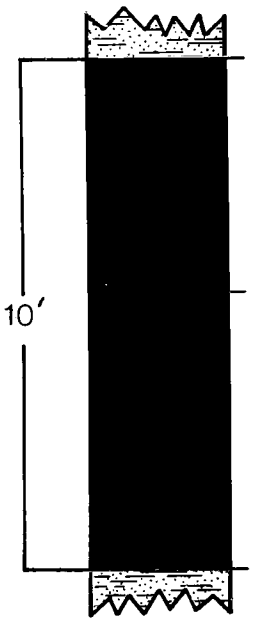
USGS TOPOGRAPHIC QUADRANGLE:
Rattlesnake Butte 7.5' (1971)

DRILL HOLE: Energy Fuels W-35

MINE TYPE: --

OPERATOR/OWNER: Energy Fuels Corp.

WADGE COAL BED



INTERBEDDED SANDSTONE, SHALE

4.0' COAL: Not sampled.

6.0' COAL: Sample No. 76-DJ-27, dull to bright attritus, very hard, poorly developed cleat.

INTERBEDDED SANDSTONE, SHALE

ANALYSES LABORATORY NUMBERS
USBM/DOE: K69865
USGS: D184646

APPARENT RANK OF COAL:
High-volatile C bituminous

THICKNESS OF COAL:
Feet: 10 Meters: 3.1

THICKNESS SAMPLED:
Feet: 6.0 Meters: 1.8

TYPE OF SAMPLE: Drill Core: Coal

GREEN RIVER REGION
YAMPA FIELD

ROUTT COUNTY

SAMPLE NUMBER: 76-DJ-26

COAL BED NAME: Wadge

GEOLOGIC ROCK UNIT: Mesaverde Group
Williams Fork Fm

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: 11 Meters: 3.35

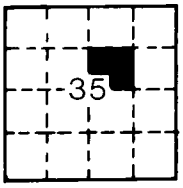
OVERBURDEN AT SAMPLING POINT:
Feet: 1284 Meters: 391.5

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 35

TOWNSHIP: 5 N

RANGE: 87 W

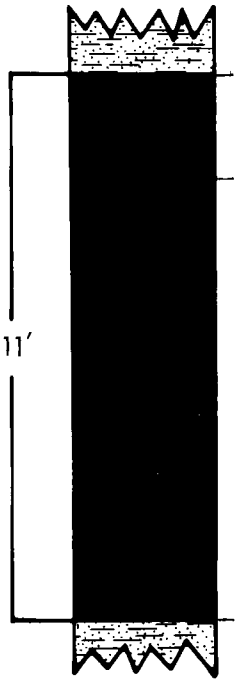
USGS TOPOGRAPHIC QUADRANGLE:
Rattlesnake Butte 7.5' (1971)

DRILL HOLE: Energy Fuels W-36

MINE TYPE: --

OPERATOR/OWNER: Energy Fuels Corp.

WADGE COAL BED



SHALY SANDSTONE

2.0' COAL: Not sampled.

9.0' COAL: Sample No. 76-DJ-26, banded, thick vitrain bands in dull to bright attritus.

SANDY SHALE

ANALYSES LABORATORY NUMBERS
USBM/DOE: K69864
USGS: D184645

APPARENT RANK OF COAL:
High-volatile C bituminous

THICKNESS OF COAL:
Feet: 11 Meters: 3.35

THICKNESS SAMPLED:
Feet: 9.0 Meters: 2.7

TYPE OF SAMPLE: Drill Core: Coal

GREEN RIVER REGION
YAMPA FIELD

ROUTT COUNTY

SAMPLE NUMBERS: 76-DB-13,14,15

COAL BED NAME: Wolf Creek

GEOLOGIC ROCK UNIT: Williams Fork Fm

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: 1.3 Meters: 0.4

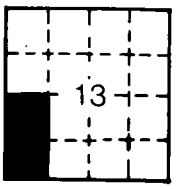
OVERBURDEN AT SAMPLING POINT:
Feet: 488 Meters: 149

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 13

TOWNSHIP: 5 N

RANGE: 86 W

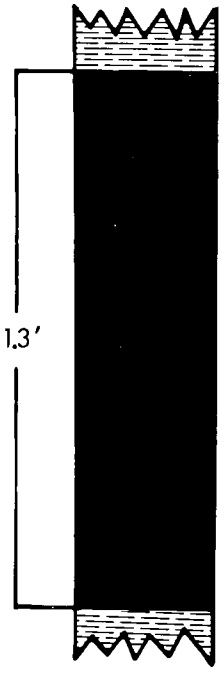
USGS TOPOGRAPHIC QUADRANGLE:
Cow Creek 7.5' (1969)

DRILL HOLE: Energy Fuels W-47

MINE TYPE: --

OPERATOR/OWNER: Energy Fuels Corp.

WOLF CREEK COAL BED



SHALE: Sample No. 76-DB-15, with sandstone and claystone lenses.

COAL: Sample No. 76-DB-14, banded abundant vitrain in attritus, blocky.

CARBONACEOUS SHALE: Sample No. 76-DB-13, few sandstone lenses.

SAMPLE NUMBER: 76-DB-13

ANALYSES LABORATORY NUMBERS
USBM/DOE: --
USGS: D188236

APPARENT RANK OF COAL:
--

THICKNESS OF COAL:
Feet: -- Meters: --

THICKNESS SAMPLED:
Feet: 0.5 Meters: 0.15

TYPE OF SAMPLE: Drill Core: Floor

SAMPLE NUMBER: 76-DB-14

ANALYSES LABORATORY NUMBERS
USBM/DOE: K72355
USGS: D188252

APPARENT RANK OF COAL:
High-volatile C bituminous

THICKNESS OF COAL:
Feet: 8.5 Meters: 2.6

THICKNESS SAMPLED:
Feet: 1.3 Meters: 0.4

TYPE OF SAMPLE: Drill Core: Coal

SAMPLE NUMBER: 76-DB-15

ANALYSES LABORATORY NUMBERS
USBM/DOE: --
USGS: D188237

APPARENT RANK OF COAL:

THICKNESS OF COAL:
Feet: -- Meters: --

THICKNESS SAMPLED:
Feet: 0.5 Meters: 0.15

TYPE OF SAMPLE: Drill Core: Roof

GREEN RIVER REGION
YAMPA FIELD

ROUTT COUNTY

SAMPLE NUMBERS: 76-DB-17,16,12

COAL BED NAME: Wadge

GEOLOGIC ROCK UNIT: William Fork Fm

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: 9.5 Meters: 2.9

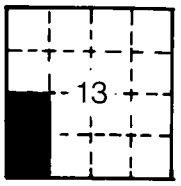
OVERBURDEN AT SAMPLING POINT:
Feet: 335 Meters: 102

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 13

TOWNSHIP: 5 N

RANGE: 86 W

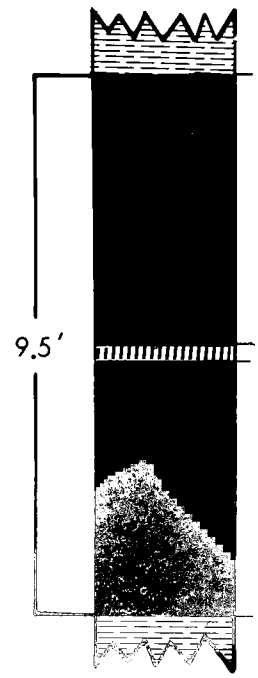
USGS TOPOGRAPHIC QUADRANGLE:
Cow Creek 7.5' (1969)

DRILL HOLE: Energy Fuels W-47

MINE TYPE: --

OPERATOR/OWNER: Energy Fuels Corp.

WADGE COAL BED



SHALE: Sample No. 76-DB-17.

3.5' COAL: Sample No. 76-DB-16 (8.5' total), 50% vitrain, 40% fusain, 10% attritus, fusain pods 0.5" in diameter.

0.1' SHALE: carbonaceous.

5.9' COAL: Sample No. 76-DB-12, as above, trace pyrite.

CARBONACEOUS SHALE: black, dense, interbedded with very fine-grained sandstone.

SAMPLE NUMBER: 76-DB-17

ANALYSES LABORATORY NUMBERS
USBM/DOE: --
USGS: D188238

APPARENT RANK OF COAL:

THICKNESS OF COAL:
Feet: -- Meters: --

THICKNESS SAMPLED:
Feet: 1 Meters: 0.3

TYPE OF SAMPLE: Drill Core: Roof

SAMPLE NUMBER: 76-DB-16

ANALYSES LABORATORY NUMBERS
USBM/DOE: K72356
USGS: D188254

APPARENT RANK OF COAL:
High-volatile C bituminous

THICKNESS OF COAL:
Feet: 9.5 Meters: 2.9

THICKNESS SAMPLED:
Feet: 3.5 Meters: 1.07

TYPE OF SAMPLE: Drill Core: Coal

SAMPLE NUMBER: 76-DB-12

ANALYSES LABORATORY NUMBERS
USBM/DOE: K72356
USGS: D188253

APPARENT RANK OF COAL:
High-volatile C bituminous

THICKNESS OF COAL:
Feet: 9.5 Meters: 2.9

THICKNESS SAMPLED:
Feet: 5.9 Meters: 1.8

TYPE OF SAMPLE: Drill Core: Coal

GREEN RIVER REGION
YAMPA FIELD

ROUTT COUNTY

SAMPLE NUMBER: 76-DJ-28,29

COAL BED NAME: Wolf Creek "A & B"

GEOLOGIC ROCK UNIT: Lower Williams Fork Fm

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: 38 Meters: 12

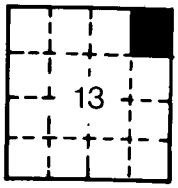
OVERBURDEN AT SAMPLING POINT:
Feet: 1113 Meters: 339.3

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 13

TOWNSHIP: 5 N

RANGE: 86 W

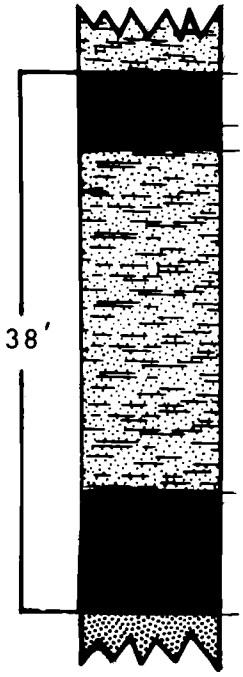
USGS TOPOGRAPHIC QUADRANGLE:
Cow Creek 7.5' (1969)

DRILL HOLE: Energy Fuels W-50

MINE TYPE: --

OPERATOR/OWNER: Energy Fuels Corp.

LOWER WOLF CREEK, "A & B" COAL BED



INTERBEDDED SANDSTONE, SILTSTONE

3.0' COAL: Not sampled.

1.0' COAL: Sample No. 76-DJ-28, dull to bright attritus, fair cleat development.

INTERBEDDED SANDSTONE, SILTSTONE

9.0' COAL: Sample No. 76-DJ-29, dull to bright attritus, good cleat development.

SANDSTONE: few siltstone lenses.

SAMPLE NUMBER: 76-DJ-28

ANALYSES LABORATORY NUMBERS
USBM/DOE: K72353
USGS: D188250

APPARENT RANK OF COAL:
High-volatile C bituminous

THICKNESS OF COAL:
Feet: 4.0 Meters: 1.2

THICKNESS SAMPLED:
Feet: 1.0 Meters: 0.3

TYPE OF SAMPLE: Drill Core: Coal

GREEN RIVER REGION
YAMPA FIELD

SAMPLE NUMBER: 76-DJ-29

ANALYSES LABORATORY NUMBERS
USBS/DOE: K72354
USGS: D188251

APPARENT RANK OF COAL:
High-volatile C bituminous

THICKNESS OF COAL:
Feet: 9 Meters: 2.7

THICKNESS SAMPLED:
Feet: 9 Meters: 2.7

TYPE OF SAMPLE: Drill Core: Coal

GREEN RIVER REGION
YAMPA FIELD

MOFFAT COUNTY

SAMPLE NUMBER: C-1C-H Run 1

COAL BED NAME: Unnamed

GEOLOGIC ROCK UNIT: Williams Fork

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 34 Meters: 10.4

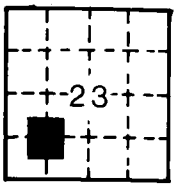
OVERBURDEN AT SAMPLING POINT:
Feet: 176.5 Meters: 53.8

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 23

TOWNSHIP: 4 N

RANGE: 91 W

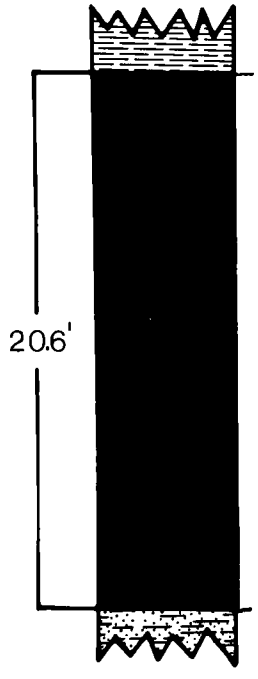
USGS TOPOGRAPHIC QUADRANGLE:
Hamilton 7.5' (1966)

DRILL HOLE: USGS C-1C-H

MINE TYPE: --

OPERATOR/OWNER: USGS Conservation Division

COAL BED NAME UNKNOWN



SHALE: medium to dark gray, laminated, carbonaceous stringers at base.

COAL: Sample No. C-1C-H Run 1, dominant thick vitrain bands in moderately bright attritus, poor cleavage development.

SILTSTONE: dark gray, laminated, coal stringers.

ANALYSES LABORATORY NUMBERS
USBM/DOE: K89040
USGS: --

APPARENT RANK OF COAL:
Subbituminous A/
High-volatile C bituminous

THICKNESS OF COAL:
Feet: 20.6 Meters: 6.28

THICKNESS SAMPLED:
Feet: 20.6 Meters: 6.28

TYPE OF SAMPLE: Drill Core: Coal

GREEN RIVER REGION
YAMPA FIELD

MOFFAT COUNTY

SAMPLE NUMBER: C-1C-H Run 19

COAL BED NAME: Unnamed

GEOLOGIC ROCK UNIT: Williams Fork Fm

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 12.6 Meters: 3.8

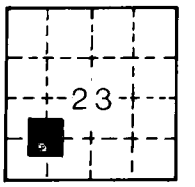
OVERBURDEN AT SAMPLING POINT:
Feet: 644 Meters: 196

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 23

TOWNSHIP: 4 N

RANGE: 91 W

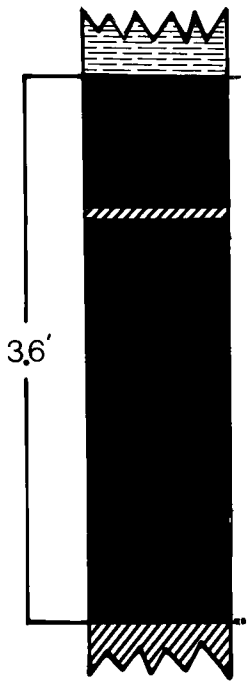
USGS TOPOGRAPHIC QUADRANGLE:
Hamilton 7.5' (1966)

DRILL HOLE: USGS C-1C-H

MINE TYPE: --

OPERATOR/OWNER: USGS Conservation Division

COAL BED NAME UNKNOWN



INTERBEDDED SILTSTONE AND SHALE: gray.

COAL: Sample No. C-1C-H Run 19, friable, occasionally shaly, few very fine vitrain bands in moderately bright attritus, minor pyrite on fracture surfaces.

ANALYSES LABORATORY NUMBERS
USBM/DOE: K89077
USGS: --

APPARENT RANK OF COAL:
High-volatile C bituminous

THICKNESS OF COAL:
Feet: 3.6 Meters: 1.1

THICKNESS SAMPLED:
Feet: 3.6 Meters: 1.1

TYPE OF SAMPLE: Drill Core: Coal

GREEN RIVER REGION
YAMPA FIELD

MOFFAT COUNTY

SAMPLE NUMBER: C-1C-H Run 28

COAL BED NAME: Unnamed

GEOLOGIC ROCK UNIT: Williams Fork Fm

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 5 Meters: 1.5

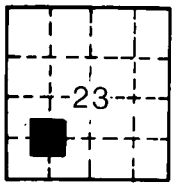
OVERBURDEN AT SAMPLING POINT:
Feet: 720.9 Meters: 220

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 23

TOWNSHIP: 4 N

RANGE: 91 W

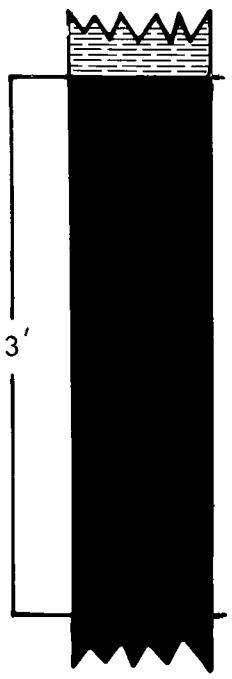
USGS TOPOGRAPHIC QUADRANGLE:
Hamilton 7.5' (1966)

DRILL HOLE: USGS C-1C-H

MINE TYPE: --

OPERATOR/OWNER: USGS Conservation Division

COAL BED NAME UNKNOWN



CARBONACEOUS SHALE: dark gray, fissile, few vitrain bands.

COAL: Sample No. C-1C-H Run 28, sparse to moderate thin vitrain bands in moderately bright attritus, minor pyrite, trace resin.

COAL: as above.

ANALYSES LABORATORY NUMBERS
USBM/DOE: K89078
USGS: --

APPARENT RANK OF COAL:
High-volatile C bituminous

THICKNESS OF COAL:
Feet: 3 Meters: 0.9

THICKNESS SAMPLED:
Feet: 3 Meters: 0.9

TYPE OF SAMPLE: Drill Core: Coal

GREEN RIVER REGION
YAMPA FIELD

MOFFAT COUNTY

SAMPLE NUMBER: C-1C-H Run 36

COAL BED NAME: Unnamed

GEOLOGIC ROCK UNIT: Williams Fork Fm

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 9.3 Meters: 2.8

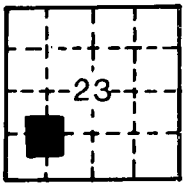
OVERBURDEN AT SAMPLING POINT:
Feet: 766.3 Meters: 233.6

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 23

TOWNSHIP: 4 N

RANGE: 91 W

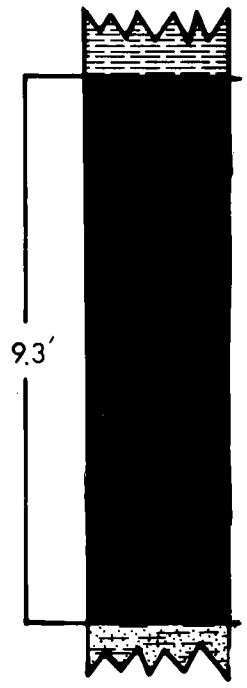
USGS TOPOGRAPHIC QUADRANGLE:
Hamilton 7.5' (1966)

DRILL HOLE: USGS C-1C-H

MINE TYPE: --

OPERATOR/OWNER: USGS Conservation Division

COAL BED NAME UNKNOWN



SILTSTONE: gray, fine carbonaceous stringers just above base.

COAL: Sample No. C-1C-H Run 36, very hard thin to thick vitrain bands in moderate to bright attritus, pyrite on fracture surfaces, strong vertical fractures.

SILTSTONE: gray.

ANALYSES LABORATORY NUMBERS
USBM/DOE: K89079
USGS: --

APPARENT RANK OF COAL:
High-volatile C bituminous

THICKNESS OF COAL:
Feet: 9.3 Meters: 2.8

THICKNESS SAMPLED:
Feet: 9.3 Meters: 2.8

TYPE OF SAMPLE: Drill Core: Coal

GREEN RIVER REGION
YAMPA FIELD

MOFFAT COUNTY

SAMPLE NUMBER: C-1C-H Run 41

COAL BED NAME: Unnamed

GEOLOGIC ROCK UNIT: Williams Fork Fm

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 7.3 Meters: 2.2

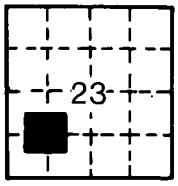
OVERBURDEN AT SAMPLING POINT:
Feet: 799.8 Meters: 243.8

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 23

TOWNSHIP: 4 N

RANGE: 91 W

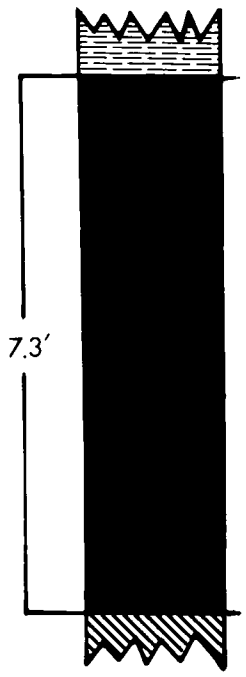
USGS TOPOGRAPHIC QUADRANGLE:
Hamilton 7.5' (1966)

DRILL HOLE: USGS C-1C-H

MINE TYPE: --

OPERATOR/OWNER: USGS Conservation Division

COAL BED NAME UNKNOWN



SHALE: gray, soft, very silty.

COAL: Sample No. C-1C-H Run 41, solid, sparse vitrain bands in moderately bright attritus, calcite in fractures, some pyrite.

ANALYSES LABORATORY NUMBERS
USBM/DOE: K89080
USGS: --

APPARENT RANK OF COAL:
High-volatile C bituminous

THICKNESS OF COAL:
Feet: 7.3 Meters: 2.2

THICKNESS SAMPLED:
Feet: 7.3 Meters: 2.2

TYPE OF SAMPLE: Drill Core: Coal

Table B1. Proximate and ultimate analyses, heat-of-combustion, forms-of-sulfur, free-swelling-index and ash-fusion-temperature determinations for nine coal samples from the Green River Region, Colorado.

[All analyses except heat-of-combustion, free-swelling index, and ash-fusion temperatures in percent. For each sample number, the analyses are reported three ways: first, as received; second, moisture free; and third, moisture and ash free. All analyses by Coal Analysis Section, U.S. Department of Energy, Pittsburgh, Pa. °F = (°C x 1.8) + 32; Kcal/kg = 0.556 (Btu/lb), L, less than the value shown]

Sample number	Proximate analysis				Ultimate analysis					Heat of combustion	
	Moisture	Volatile matter	Fixed carbon	Ash	Hydrogen	Carbon	Nitrogen	Oxygen	Sulfur	Kcal/kg	Btu/lb
D184639*	12.0	34.7	43.6	9.7	5.5	59.9	1.5	22.6	0.7	5,870	10,560
	---	39.4	49.5	11.0	4.7	68.1	1.7	13.6	.8	6,670	12,000
	---	44.3	55.7	---	5.3	76.5	1.9	15.2	.9	7,490	13,490
D184642*	12.7	33.1	45.0	9.2	5.4	58.9	1.5	24.5	.6	5,720	10,300
	---	37.9	51.5	10.5	4.6	67.5	1.7	15.1	.7	6,550	11,800
	---	42.4	57.6	---	5.1	75.4	1.9	16.9	.8	7,330	13,190
D188255*	11.4	34.3	50.3	4.0	5.8	65.4	1.3	23.0	.4	6,330	11,400
	---	38.7	56.8	4.5	5.1	73.8	1.5	14.5	.5	7,150	12,870
	---	40.5	59.5	---	5.4	77.3	1.5	15.2	.5	7,490	13,470
D184645	8.2	34.2	50.1	7.5	5.4	66.9	1.7	18.1	.5	6,580	11,840
	---	37.3	54.6	8.2	4.9	72.9	1.9	11.8	.5	7,170	12,900
	---	40.6	59.4	---	5.3	79.4	2.0	12.8	.6	7,810	14,050
D184646	8.2	35.6	49.8	6.4	5.6	67.4	1.7	18.4	.4	6,670	12,010
	---	38.8	54.2	7.0	5.1	73.4	1.9	12.1	.4	7,270	13,080
	---	41.7	58.3	---	5.5	78.9	2.0	13.0	.5	7,810	14,060
D188253*	8.8	33.9	49.5	7.8	5.6	65.1	1.6	19.4	.6	6,390	11,500
	---	37.2	54.3	8.6	5.1	71.4	1.8	12.7	.7	7,010	12,610
	---	40.6	59.4	---	5.5	78.1	1.9	13.9	.7	7,660	13,790
D188252	9.6	35.2	50.1	5.1	5.8	66.6	1.6	20.3	.6	6,530	11,760
	---	38.9	55.4	5.6	5.2	73.7	1.8	13.0	.7	7,230	13,010
	---	41.3	58.7	---	5.5	78.1	1.9	13.8	.7	7,660	13,780
D188250	7.3	33.8	38.7	20.2	5.1	55.8	1.2	16.8	.9	5,480	9,870
	---	36.5	41.7	21.8	4.6	60.2	1.3	11.1	1.0	5,920	10,650
	---	46.6	53.4	---	5.9	77.0	1.7	14.2	1.2	7,560	13,620
D188251	8.7	36.5	44.2	10.6	5.6	63.1	1.5	18.9	.4	6,180	11,130
	---	40.0	48.4	11.6	5.1	69.1	1.6	12.2	.4	6,770	12,190
	---	45.2	54.8	---	5.7	78.2	1.9	13.8	.5	7,660	13,790

[Sample D184639 is a composite of sample D184639, D184640 and D184641; D184642* is a composite of D184642 and D184643; D188255 and D188256; D188253* is a composite of samples D188253 and D188254.]

Table B1. Proximate and ultimate analyses, heat-of-combustion, forms-of-sulfur, free-swelling-index and ash-fusion-temperature determinations for nine coal samples from the Green River Region, Colorado (cont.).

Sample number	Air-dried loss	Forms of sulfur			Free swelling	Ash fusion temperature, °C		
		Sulfate	Pyritic	Organic		Initial deformation	Softening	Fluid
D184639*	5.8	0.04	0.10	0.60	0.0	1,540+	1,540+	1,540+
	---	.05	.11	.68				
	---	.05	.13	.77				
D184642*	6.3	.01	.07	.49	.0	1,540+	1,540+	1,540+
	---	.01	.08	.56				
	---	.01	.09	.63				
D188255*	3.8	.01	.13	.30	.0	1,255	1,320	1,375
	---	.01	.15	.34				
	---	.01	.15	.35				
D184645	2.1	.01	.02	.43	.0	1,285	1,350	1,405
	---	.01	.02	.47				
	---	.01	.02	.51				
D184646	2.4	.02	.08	.35	.0	1,540+	1,540+	1,540+
	---	.02	.09	.38				
	---	.02	.09	.41				
D188253*	1.5	.01	.21	.34	.0	1,540+	1,540+	1,540+
	---	.01	.23	.37				
	---	.01	.25	.41				
D188252	2.6	.01	.19	.40	.0	1,325	1,380	1,430
	---	.01	.21	.44				
	---	.01	.22	.47				
D188250	1.6	.01	.27	.62	.0	1,540+	1,540+	1,540+
	---	.01	.29	.67				
	---	.01	.37	.86				
D188251	2.1	.01	.17	.24	.0	1,540+	1,540+	1,540+
	---	.01	.19	.26				
	---	.01	.21	.30				

[Sample D184639 is a composite of sample D184639, D184640 and D184641; D184642* is a composite of D184642 and D184643; D188255 and D188256; D188253* is a composite of samples D188253 and D188254.]

Table B2. Major- and minor-oxide and trace element composition of the laboratory ash of 21 coal and coal-associated rock samples from the Green River Region, Colorado.

[Values in percent or parts per million. Coal and shale ashed at 525°C. S after element title indicates determinations by semiquantitative emission spectrography. The spectrographic results are to be identified with geometric brackets whose boundaries are part of the ascending series 0.12, 0.18, 0.26, 0.38, 1.2, etc. but reported as midpoints of the brackets, 0.1, 0.15, 0.2, 0.3, 0.5, 0.7, 1.0, etc. Precision of the spectrographic data is plus-or-minus one bracket at 68 percent or plus-or-minus two brackets at 95 percent confidence level. L, less than the value shown; N, not detected].

Sample number	Ash (percent)	SiO2 (percent)	Al2O3 (percent)	CaO (percent)	MgO (percent)	Na2O (percent)	K2O (percent)	Fe2O3 (percent)	TiO2 (percent)	P2O5 (percent)	Sample number
D184639	10.5	49	26	7.5	1.61	0.17	0.55	3.0	0.72	1.0L	D184639
D184640	8.4	45	26	10	1.37	.16	.61	2.8	1.1	1.0L	D184640
D184641	12.7	52	24	4.9	.75	.21	1.0	3.9	.89	1.0L	D184641
D188239	29.9	65	19	2.3	1.19	.21	2.2	3.8	.81	1.0L	D188239
D184642	7.0	46	26	7.0	.94	.14	.59	3.8	1.0	1.0L	D184642
D184643	21.8	67	17	1.8	.57	.23	1.4	2.5	.69	1.0L	D184643
D188240	91.1	72	14	.99	.81	.65	3.1	1.3	.73	1.0L	D188240
D188255	5.1	37	26	11	.91	4.20	.43	3.4	1.4	2.1	D188255
D188256	4.1	18	22	20	1.02	5.33	.22	4.1	1.8	11	D188256
D188245	94.8	70	20	2.0	.73	.77	2.4	1.3	.84	1.0L	D188245
D188246	94.5	66	15	8.9	.83	.39	1.7	1.9	.40	1.0L	D188246
D184646	6.9	46	27	8.9	1.14	1.25	.74	3.0	1.1	1.1	D184646
D184645	8.9	54	20	9.4	1.71	1.00	.85	2.6	.86	1.3	D184645
D188238	91.9	71	15	2.2	1.58	.62	2.7	4.3	.79	1.0L	D188238
D188254	7.6	41	27	7.8	1.08	1.30	.86	7.3	1.0	1.1	D188254
D188253	9.1	46	33	6.7	1.05	1.28	.85	2.7	1.2	1.0L	D188253
D188237	24.0	51	40	2.8	.26	.45	.75	.40	1.1	1.0L	D188237
D188252	4.8	20	24	23	1.20	1.48	.29	4.0	1.4	9.7	D188252
D188236	79.5	84	8.5	.35	.39	.48	2.0	.60	.65	1.0L	D188236
D188250	21.4	64	23	1.9	.63	.83	1.5	2.1	.89	1.0L	D188250
D188251	10.5	47	24	8.6	1.19	1.50	.82	2.8	1.3	2.2	D188251

Table B2. Major- and minor-oxide and trace element composition of the laboratory ash of 21 coal and coal-associated rock samples from the Green River Region, Colorado (cont.).

Sample number	SO3 (percent)	B-S (ppm)	Ba-S (ppm)	Be-S (ppm)	Cd (ppm)	Ce-S (ppm)	Co-S (ppm)	Cr-S (ppm)	Cu (ppm)	Ga-S (ppm)	Sample number
D184639	5.7	700	700	7	1.0L	500L	10	15	50	30	D184639
D184640	7.2	1,000	1,500	5	1.0L	500L	15	15	67	30	D184640
D184641	4.2	500	1,000	7	1.0L	500L	15	20	83	30	D184641
D188239	1.9	300	500	15	2.0	N	20	100	60	30	D188239
D184642	5.8	1,500	1,000	5	1.0L	500L	15	15	73	30	D184642
D184643	1.8	300	300	7	1.0L	N	15	30	43	20	D184643
D188240	.48	50	700	N	1.0L	N	15	70	38	15	D188240
D188255	10	1,500	7,000	3	1.0	N	15	50	95	70	D188255
D188256	13	1,500	10,000	3	1.0L	N	15	30	95	70	D188256
D188245	.91	150	700	7	2.0	N	10	150	67	30	D188245
D188246	.20L	N	700	N	1.0L	200	7	15	20L	15	D188246
D184646	3.8	1,000	3,000	7	1.0L	500L	10	15	73	30	D184646
D184645	2.9	700	3,000	5	1.0	500L	10L	15	67	30	D184645
D188238	1.0	70	700	N	1.0L	N	15	70	29	15	D188238
D188254	5.3	1,500	1,500	7	1.0	200	15	30	66	70	D188254
D188253	4.0	1,500	1,500	7	1.0	N	7	15	71	70	D188253
D188237	1.1	150	150	2	1.0L	N	7	30	57	50	D188237
D188252	8.9	1,500	7,000	7	2.0	200	20	30	99	50	D188252
D188236	.29	70	300	2	1.0L	N	5	50	20L	7	D188236
D188250	1.0	300	700	7	2.0	200	15	70	50	30	D188250
D188251	3.7	700	3,000	3	2.0	N	10	30	87	50	D188251

Sample number	Ge-S (ppm)	La-S (ppm)	Li (ppm)	Mn (ppm)	Mo-S (ppm)	Nb-S (ppm)	Nd-S (ppm)	Ni-S (ppm)	Pb (ppm)	Sc-S (ppm)	Sample number
D184639	N	100L	95	230	10	30	N	15	70	10	D184639
D184640	N	150	87	415	10	30	N	20	55	15	D184640
D184641	N	100L	99	285	10	30	N	20	40	15	D184641
D188239	20	N	69	135	N	50	N	30	65	30	D188239
D184642	N	100	98	185	7	50	N	20	65	15	D184642
D184643	N	100L	61	50	7L	30	N	20	30	15	D184643
D188240	N	70	28	65	N	20	N	30	25	7	D188240
D188255	N	150	115	40	20	30	N	30	40	15	D188255
D188256	N	70	69	75	10	20	N	30	50	15	D188256
D188245	20	70	125	30	N	30	N	15	35	15	D188245
D188246	N	150	26	220	N	20	N	5	30	7	D188246
D184646	N	100	119	50	7	50	N	15	80	15	D184646
D184645	N	100L	60	210	7	50	N	15	100	15	D184645
D188238	N	N	52	235	N	20	N	30	25	15	D188238
D188254	N	150	145	60	7	30	150	15	80	30	D188254
D188253	N	70	183	30	5	50	N	7	120	30	D188253
D188237	N	70	186	30	N	20	N	5	65	10	D188237
D188252	N	150	161	145	5	30	150	30	70	15	D188252
D188236	N	N	27	25	N	30	N	7	25L	7	D188236
D188250	N	150	98	35	N	20	N	10	125	15	D188250
D188251	N	150	77	225	5	30	N	10	310	15	D188251

Table B2. Major- and minor-oxide and trace element composition of the laboratory ash of 21 coal and coal-associated rock samples from the Green River Region, Colorado (cont.).

Sample number	Sr-S (ppm)	V-S (ppm)	Y-S (ppm)	Yb-S (ppm)	Zn (ppm)	Zr-S (ppm)	Sample number
D184639	300	30	70	7	49	200	D184639
D184640	700	70	70	7	43	300	D184640
D184641	300	70	50	5	82	200	D184641
D188239	150	150	70	7	342	700	D188239
D184642	700	50	70	7	47	200	D184642
D184643	70	70	30	3	106	200	D184643
D188240	70	70	30	3	113	200	D188240
D188255	2,000	150	70	7	32	200	D188255
D188256	7,000	70	70	5	44	150	D188256
D188245	100	200	30	5	303	150	D188245
D188246	150	30	30	3	112	150	D188246
D184646	1,500	70	70	7	91	300	D184646
D184645	1,000	50	70	7	202	300	D184645
D188238	150	70	50	5	134	150	D188238
D188254	1,500	70	100	10	96	300	D188254
D188253	1,500	50	70	7	59	300	D188253
D188237	150	70	30	2	44	200	D188237
D188252	7,000	70	150	7	65	200	D188252
D188236	70	70	50	5	66	700	D188236
D188250	700	70	70	7	224	300	D188250
D188251	1,500	70	70	7	159	300	D188251

Table B3. Content of 7 trace elements in 21 coal and coal-associated rock samples from the Green River Region, Colorado.

[Analyses on air-dried (32°C) coal and shale. L, less than the value shown]

Sample number	As (ppm)	F (ppm)	Hg (ppm)	Sb (ppm)	Se (ppm)	Th (ppm)	U (ppm)	Sample number
D184639	0.8	80	0.01	0.2	1.4	4.2	1.9	D184639
D184640	.7	70	.01	.2	1.2	3.6	1.4	D184640
D184641	1.0	75	.03	.2	1.2	3.1	1.3	D184641
D188239	1.2	250	.25	2.3	.6	8.0	3.6	D188239
D184642	1.0	70	.02	.2	1.2	2.8	1.0	D184642
D184643	3.8	80	.07	.5	2.1	3.7	1.5	D184643
D188240	6.5	670	.13	1.7	2.2	15	4.7	D188240
D188255	.6	55	.02	.3	1.4	1.5	1.5	D188255
D188256	.4	150	.02	.7	2.1	7.0	.8	D188256
D188245	1.0	380	.22	2.8	2.7	7.0	6.2	D188245
D188246	2.5	450	.11	.5	2.3	11	3.5	D188246
D184646	.5	75	.01	.1	B	2.5	.9	D184646
D184645	.4	190	.01	.2	.6	2.1	1.1	D184645
D188238	4.5	860	.24	1.1	2.2	9.0	4.4	D188238
D188254	1.2	60	.15	.2	1.2	3.5	1.5	D188254
D188253	.3	20	.02	.2	1.1	3.8	1.8	D188253
D188237	.5	60	.03	.5	6.4	3.0L	4.9	D188237
D188252	.2	150	.03	.1	.7	.9	1.2	D188252
D188236	1.5	220	.05	.7	.9	9.0	3.7	D188236
D188250	1.5	120	.05	.3	.1L	6.1	2.5	D188250
D188251	.4	55	.02	.3	1.1	3.4	1.7	D188251

Table B4. Major-, minor- and trace-element composition of 21 coal and coal-associated rock samples from the Green River Region, Colorado.

[Values in percent or parts per million. As, F, Hg, Sb, Se, Th, and U values are from direct determinations on air-dried (32°C) coal and shale; all other values calculated from analyses of ash. S means analysis by emission spectrography; L, less than the value shown; N, not detected].

Sample number	Si (percent)	Al (percent)	Ca (percent)	Mg (percent)	Na (percent)	K (percent)	Fe (percent)	Ti (percent)	As (ppm)	B-S (ppm)	Sample number
D184639	2.4	1.4	0.56	0.10	0.013	0.048	0.22	0.045	0.8	70	D184639
D184640	1.8	1.2	.60	.069	.010	.043	.16	.055	.7	100	D184640
D184641	3.1	1.6	.44	.057	.020	.11	.35	.068	1.0	70	D184641
D188239	9.1	3.0	.49	.21	.047	.55	.79	.15	1.2	100	D188239
D184642	1.5	.96	.35	.040	.007	.034	.19	.042	1.0	100	D184642
D184643	6.8	2.0	.28	.075	.037	.25	.38	.090	3.8	70	D184643
D188240	31	6.7	.64	.44	.44	2.4	.83	.40	6.5	50	D188240
D188255	.88	.70	.40	.028	.16	.018	.12	.043	.6	70	D188255
D188256	.34	.48	.59	.025	.16	.008	.12	.044	.4	70	D188256
D188245	31	10	1.4	.42	.54	1.9	.86	.48	1.0	150	D188245
D188246	29	7.5	6.0	.47	.27	1.3	1.3	.23	2.5	N	D188246
D184646	1.5	.99	.44	.047	.064	.043	.14	.045	.5	70	D184646
D184645	2.2	.94	.60	.092	.066	.063	.16	.046	.4	70	D184645
D188238	30	7.3	1.4	.87	.42	2.1	2.8	.43	4.5	70	D188238
D188254	1.5	1.1	.42	.049	.073	.054	.39	.046	1.2	100	D188254
D188253	2.0	1.6	.44	.058	.086	.064	.17	.065	.3	150	D188253
D188237	5.7	5.1	.48	.038	.080	.15	.067	.16	.5	30	D188237
D188252	.45	.61	.79	.035	.053	.012	.13	.040	.2	70	D188252
D188236	31	3.6	.20	.19	.28	1.3	.33	.31	1.5	50	D188236
D188250	6.4	2.6	.29	.081	.13	.27	.31	.11	1.5	70	D188250
D188251	2.3	1.3	.64	.075	.12	.072	.21	.082	.4	70	D188251

Table B4. Major-, minor- and trace-element composition of 21 coal and coal-associated rock samples from the Green River Region, Colorado (cont.).

Sample number	Ba-S (ppm)	Be-S (ppm)	Cd (ppm)	Ce-S (ppm)	Co-S (ppm)	Cr-S (ppm)	Cu (ppm)	F (ppm)	Ga-S (ppm)	Ge-S (ppm)	Sample number
D184639	70	0.7	0.11L	50L	1	1.5	5.3	80	3	N	D184639
D184640	150	.5	.08L	50L	1.5	1.5	5.6	70	2	N	D184640
D184641	150	1	.13L	70L	2	2	11	75	3	N	D184641
D188239	150	5	.60	N	7	30	18	250	10	7	D188239
D184642	70	.3	.07L	30L	1	1	5.1	70	2	N	D184642
D184643	70	1.5	.22L	N	3	7	9.4	80	5	N	D184643
D188240	700	N	.91L	N	15	70	35	670	15	N	D188240
D188255	300	.15	.05	N	.7	2	4.8	55	3	N	D188255
D188256	500	.15	.04L	N	.7	1.5	3.9	150	3	N	D188256
D188245	700	7	1.9	N	10	150	64	380	30	20	D188245
D188246	700	N	.95L	200	7	15	19L	450	15	N	D188246
D184646	200	.5	.07L	30L	.7	1	5.0	75	2	N	D184646
D184645	300	.5	.09	50L	1L	1.5	6.0	190	3	N	D184645
D188238	700	N	.92L	N	15	70	27	860	15	N	D188238
D188254	100	.5	.08	15	1	2	5.0	60	5	N	D188254
D188253	150	.7	.09	N	.7	1.5	6.5	20	7	N	D188253
D188237	30	.5	.24L	N	1.5	7	14	60	10	N	D188237
D188252	300	.3	.10	10	1	1.5	4.8	150	2	N	D188252
D188236	200	1.5	.80L	N	5	50	16L	220	5	N	D188236
D188250	150	1.5	.43	50	3	15	11	120	7	N	D188250
D188251	300	.3	.21	N	1	3	9.1	55	5	N	D188251

Sample number	Hg (ppm)	La-S (ppm)	Li (ppm)	Mn (ppm)	Mo-S (ppm)	Nb-S (ppm)	Nd-S (ppm)	Ni-S (ppm)	P (ppm)	Pb (ppm)	Sample number
D184639	0.01	10L	10	24	1	3	N	1.5	460L	7.4	D184639
D184640	.01	15	7.3	35	1	2	N	1.5	370L	4.6	D184640
D184641	.03	15L	13	36	1.5	3	N	2	550L	5.1	D184641
D188239	.25	N	21	40	N	15	N	10	1,300L	19	D188239
D184642	.02	7	6.9	13	.5	3	N	1.5	310L	4.6	D184642
D184643	.07	20L	13	11	1.5L	7	N	5	950L	6.5	D184643
D188240	.13	70	26	59	N	20	N	30	4,000L	23	D188240
D188255	.02	7	5.9	2.0	1	1.5	N	1.5	470	2.0	D188255
D188256	.02	3	2.8	3.1	.5	.7	N	1.5	2,000	2.1	D188256
D188245	.22	70	120	28	N	30	N	15	4,100L	33	D188245
D188246	.11	150	25	210	N	20	N	5	4,100L	28	D188246
D184646	.01	7	8.2	3.5	.5	3	N	1	330	5.5	D184646
D184645	.01	10L	5.3	19	.7	5	N	1.5	510	8.9	D184645
D188238	.24	N	48	220	N	20	N	30	4,000L	23	D188238
D188254	.15	10	11	4.6	.5	2	10	1	370	6.1	D188254
D188253	.02	7	17	2.7	.5	5	N	.7	400L	11	D188253
D188237	.03	15	45	7.2	N	5	N	1	1,000L	16	D188237
D188252	.03	7	7.7	7.0	.2	1.5	7	1.5	2,000	3.4	D188252
D188236	.05	N	21	20	N	20	N	5	3,500L	20L	D188236
D188250	.05	30	21	7.5	N	5	N	2	940L	27	D188250
D188251	.02	15	8.1	24	.5	3	N	1	1,000	33	D188251

Table B4. Major-, minor- and trace-element composition of 21 coal and coal-associated rock samples from the Green River Region, Colorado (cont.).

Sample number	Sb (ppm)	Sc-S (ppm)	Se (ppm)	Sr-S (ppm)	Th (ppm)	U (ppm)	V-S (ppm)	Y-S (ppm)	Yb-S (ppm)	Zn (ppm)	Sample number
D184639	0.2	1	1.4	30	4.2	1.9	3	7	0.7	5.1	D184639
D184640	.2	1.5	1.2	70	3.6	1.4	7	7	.7	3.6	D184640
D184641	.2	2	1.2	30	3.1	1.3	10	7	.7	10	D184641
D188239	2.3	10	.6	50	8.0	3.6	50	20	2	100	D188239
D184642	.2	1	1.2	50	2.8	1.0	3	5	.5	3.3	D184642
D184643	.5	3	2.1	15	3.7	1.5	15	7	.7	23	D184643
D188240	1.7	7	2.2	70	15.0	4.7	70	30	3	100	D188240
D188255	.3	.7	1.4	100	1.5	1.5	7	3	.3	1.6	D188255
D188256	.7	.7	2.1	300	7.0	.8	3	3	.2	1.8	D188256
D188245	2.8	15	2.7	100	7.0	6.2	200	30	5	290	D188245
D188246	.5	7	2.3	150	11.0	3.5	30	30	3	110	D188246
D184646	.1	1	B	100	2.5	.9	5	5	.5	6.3	D184646
D184645	.2	1.5	.6	100	2.1	1.1	5	7	.7	18	D184645
D188238	1.1	15	2.2	150	9.0	4.4	70	50	5	120	D188238
D188254	.2	2	1.2	100	3.5	1.5	5	7	.7	7.3	D188254
D188253	.2	3	1.1	150	3.8	1.8	5	7	.7	5.4	D188253
D188237	.5	2	6.4	30	3.0L	4.9	15	7	.5	11	D188237
D188252	.1	.7	.7	300	.9	1.2	3	7	.3	3.1	D188252
D188236	.7	5	.9	50	9.0	3.7	50	50	5	52	D188236
D188250	.3	3	.1L	150	6.1	2.5	15	15	1.5	48	D188250
D188251	.3	1.5	1.1	150	3.4	1.7	7	7	.7	17	D188251

Table B5. Arithmetic mean, observed range, geometric mean, and geometric deviation of proximate and ultimate analyses, heat of combustion, forms of sulfur, and ash-fusion temperatures of 21 coal samples from the Yampa field, Green River Region, Moffat and Routt Counties, Colorado.

[All values are in percent except Kcal/kg, Btu/lb, ash-fusion temperatures, and geometric deviation and are reported on the as-received basis. °F = (C° x 1.8) + 32; Kcal/kg = 0.556 (Btu/lb)]

	Arithmetic mean	Observed range		Geometric mean	Geometric deviation
		Minimum	Maximum		
Proximate and ultimate analyses					
Moisture	9.7	7.3	12.7	9.5	1.2
Volatile matter	34.6	33.1	36.5	34.6	1.0
Fixed carbon	46.8	38.7	50.3	46.6	1.1
Ash	9.0	4.0	20.2	8.1	1.6
Hydrogen	5.5	5.1	5.8	5.5	1.0
Carbon	63.2	55.8	67.4	63.1	1.1
Nitrogen	1.5	1.2	1.7	1.5	1.1
Oxygen	20.2	16.8	24.5	20.1	1.1
Sulfur	.6	.4	.9	.5	1.3
Heat of combustion					
Kcal/kg	6,205	5,490	6,675	6,190	1.1
Btu/lb	11,150	9,870	12,010	11,130	1.1
Forms of sulfur					
Sulfate	0.01	0.01	0.04	0.01	1.6
Pyritic	.15	.02	.27	.11	2.2
Organic	.42	.24	.62	.40	1.4
Ash-fusion temperatures, °C					
Initial deformation	1,450	1,255	1,540+	1,450	1.1
Softening temperature	1,470	1,320	1,540+	1,470	1.1
Fluid temperature	1,490	1,375	1,540+	1,490	1.1

Table B6. Arithmetic mean, observed range, geometric mean, and geometric deviation of ash content and contents of ten major and minor oxides in the laboratory ash of 21 coal samples from the Yampa field, Green River Region, Moffat and Routt Counties, Colorado.

[All samples were ashed at 525°C; all analyses except geometric deviation are in percent; L, less than the value shown]

Oxide	Arithmetic mean	Observed Range		Geometric mean	Geometric deviation
		Minimum	Maximum		
(Ash)	12.1	4.1	29.9	10.1	1.8
SiO_2	47	18	67	44	1.4
Al_2O_3	25	17	40	25	1.2
CaO	8.7	1.8	23	6.5	2.1
MgO	1.06	.26	1.71	.96	1.6
Na_2O	1.30	.14	5.33	.67	3.2
K_2O	.87	.22	2.2	.73	1.7
Fe_2O_3	3.5	.40	7.3	2.9	1.8
TiO_2	1.1	.69	1.8	1.0	1.3
SO_3	5.2	1.0L	11	4.0	2.1

Table B7. Arithmetic mean, observed range, geometric mean, and geometric deviation of 36 elements in 21 coal samples from the Yampa field, Green River Region, Moffat and Routt Counties, Colorado.

[All analyses are in percent or parts per million and are reported on a whole-coal basis. As, F, Hg, Sb, Se, Th, and U values used to calculate the statistics were determined directly on whole coal. All other values used were calculated from determinations made on coal ash. L, less than the value shown].

Element	Arithmetic mean	Observed range		Geometric mean	Geometric deviation
		Minimum	Maximum		
		Percent			
Si	3.2	0.34	9.1	2.1	2.5
Al	1.6	.47	5.1	1.3	1.8
Ca	.49	.28	.79	.47	1.3
Mg	.067	.025	.21	.058	1.7
Na	.079	.007	.16	.050	2.6
K	.12	.008	.55	.062	3.1
Fe	.24	.067	.79	.20	1.8
Ti	.070	.040	.16	.063	1.6
		Parts per million			
As	0.9	0.2	3.8	0.7	2.1
B	70	30	150	70	1.4
Ba	200	30	500	150	2.1
Be	1	.15	5	.7	2.4
Cd	.1	.04L	.60	.05	3.9
Cu	7.7	3.9	18	7.0	1.6
F	99	20	250	83	1.8
Ga	5	2	10	5	1.8
Hg	.04	.01	.25	.03	2.6
La	10	3	30	5	2.7
Li	13	2.8	45	10	1.9
Mn	16	2	40	9.8	2.7
Mo	.7	.2	1.5	.5	2.4
Nb	5	.7	15	3	2.0
Ni	2	.7	10	1.5	1.9
P	500	310L	2,000	470	7.2
Pb	10	2	33	7.3	2.3
Sb	.4	.1	2.3	.3	2.2
Sc	2	.7	10	1.5	2.0
Se	1.5	.1L	6.4	1.2	1.9
Sr	100	15	300	70	2.4
Th	3.7	.9	8.0	3.0	1.9
U	1.8	.8	4.9	1.6	1.6
V	10	3	50	7	2.2
Y	7	3	20	7	1.6
Yb	.7	.2	2	.7	1.8
Zn	16	1.6	100	8.3	3.1
Zr	30	7	200	20	2.3

Table B8. Proximate and ultimate analyses, forms of sulfur, and heat-of-combustion determinations of 10 coal samples from the Green River region.

[All analyses except heat-of-combustion are in percent. Basis represents form of analyses: 1, as received; 2, moisture free; 3, moisture and ash free.]

Sample #	Lab #	Basis	Moisture	Volatile-Matter	Fixed Carbon	Ash	H	C	N	O	S	Sulfur Forms			Heat Value	
												Sulfate	Pyritic	Organic	Btu/lb	Kcal/Kg
YAMPA FIELD																
C-1C-H																
Run 1	K89040	1	14.7	34.5	47.5	3.3	5.6	63.6	1.5	25.7	0.7	0.1	0.20	0.47	10876	6042
		2		40.4	55.8	3.8	4.6	74.2	1.7	14.8	0.8	0.1	0.23	0.55	12755	7086
		3		42.1	57.9		4.8	77.2	1.8	15.4	0.8	0.1	0.24	0.57	13263	7368
Run 19	K78077	1	10.4	33.1	48.5	8.0	5.2	62.5	1.1	22.5	0.8				10934	6074
		2		36.9	54.2	8.9	4.5	69.7	1.2	14.8	0.9				12200	6778
		3		40.6	59.4		4.9	76.6	1.3	16.3	0.9				13398	7443
Run 28	K89078	1	11.4	35.3	47.3	5.9	5.2	63.5	1.2	23.6	0.6				11052	6140
		2		39.9	53.5	6.6	4.4	71.7	1.3	15.2	0.7				12477	6932
		3		42.7	57.3		4.7	76.8	1.4	16.3	0.8				13361	7423
Run 36	K89079	1	12.0	34.8	49.1	4.0	5.2	64.3	1.5	24.5	0.6				11126	6181
		2		39.6	55.9	4.5	4.4	73.1	1.6	15.7	0.6				12645	7025
		3		41.5	58.5		4.6	76.5	1.7	16.4	0.7				13239	7355
Run 41	K89080	1	9.2	42.0	43.6	5.2	5.5	66.2	1.3	21.2	0.7				11443	6357
		2		46.2	48.1	5.7	4.9	72.9	1.4	14.4	0.8				12599	6999
		3		49.0	51.0		5.2	77.3	1.5	15.2	0.8				13360	7422
HAYDEN GULCH exploration drill hole*																
Ranges (samples 1-5)		1	16.42-19.59	32.4-34.03	41.96-43.93	5.14-8.74	3.69-4.10	56.92-59.13	1.36-1.44	10.87-12.83	0.33-0.64				9642-10172	5357-5651
All Seams		2		39.27-41.25	50.86-53.25	6.23-10.59	4.58-4.99	68.62-71.87	1.63-1.73	14.17-15.98	0.39-0.77		.04-.08	0.32-0.73	11687-12329	6493-6849
Average (samples 1-5)		1	17.51	33.31	42.93	6.24	3.97	58.24	1.42	11.89	0.43				9978	5543
All Seams		2		40.38	52.04	7.55	4.81	71.03	1.70	14.72	0.49			.04	12094	6719

*compliments of H-G Coal Co.

Section C

Chemical analyses of coal and coal-associated rock samples from the Coalmont Formation, McCallum and Coalmont areas, North Park, Jackson County, Colorado

By

Joseph R. Hatch, Dawn H. Madden and Ronald H. Affolter

Introduction

As part of a continuing program by the U.S. Geological Survey to collect and chemically analyze representative samples of U.S. coals, 44 coal and coal-associated rock samples were collected from the Paleocene and Eocene, Coalmont Formation in the McCallum and Coalmont areas, North Park, Jackson County, Colorado. Twenty-eight samples (24 coal and 4 associated rock are from the McCallum area and 16 samples (12 coal and 4 coal-associated rock) are from the Coalmont area. Locations of ten core holes and three mines where the samples were collected, and an outline of North Park are shown on figure C1. The 44 samples are briefly described in table C1.

Previous Investigations

The coal geology of North Park, Jackson County, Colo., has been discussed or mentioned in a number of reports. Beekly (1915) mapped the geology of Jackson County; Erdman (1941) mapped coal occurrences near the former town of Coalmont to determine the extent of a burning coal bed; Hail (1965, 1968) mapped the geology of western Jackson County; and Kinney (1970, 1971), Kinney and Hail (1970a,b) and Kinney and others (1970) mapped eastern Jackson County. Madden (1977a,b) carried out an exploratory drilling program in the McCallum and Coalmont areas and delineated a leasable coal area (Madden and others 1978). Hendricks (1977, 1978) studied the stratigraphy of the Coalmont Formation in the Coalmont, Colo. area.

The Coalmont Formation is the most widespread unit in the two coal areas and is the only formation containing significantly thick coal deposits. The formation is a maximum of 12,000 ft thick and consists of micaceous and arkosic sandstone, minor conglomerate, mudstone, claystone, carbonaceous shale, and coal (Hail, 1968).

The sedimentary rocks of the Coalmont Formation in the Coalmont area (fig. 1) consist of braided stream, overbank, and swamp deposits in the lower part and meandering channel, crevasse splay, levee, and swamp deposits in the upper member (Hendricks, 1977).

The two major coal beds in the Coalmont Formation are the Sudduth, which occurs 50-250 ft above the base of the Coalmont Formation, and the Riach, which occurs approximately 3,000 ft above the base. The Sudduth coal bed occurs in Kinney's (1970) arkosic member (5,500 ft thick) where the member overlies the Pierre Shale; and the Riach coal bed occurs in Hail's (1968) upper member (5,500 ft thick (fig C2)). The two coal beds have never been found together in one section. The Sudduth bed occurs only in the McCallum area in northeastern North Park and the Riach coal bed occurs only in the Coalmont area in southwestern North Park. The two areas are separated by a major east-northeast-trending fault, the Spring Creek Fault, which has 4,900 ft of displacement (Behrendt and others, 1969; Madden and others, 1978).

In the Coalmont area the Riach coal bed dips from 5° to 26° east or northeast toward the center of the basin. Numerous northwest-trending faults occur in the Coalmont area where they generally show less than 500 ft of stratigraphic displacement (Hail, 1968) and repeat the poorly

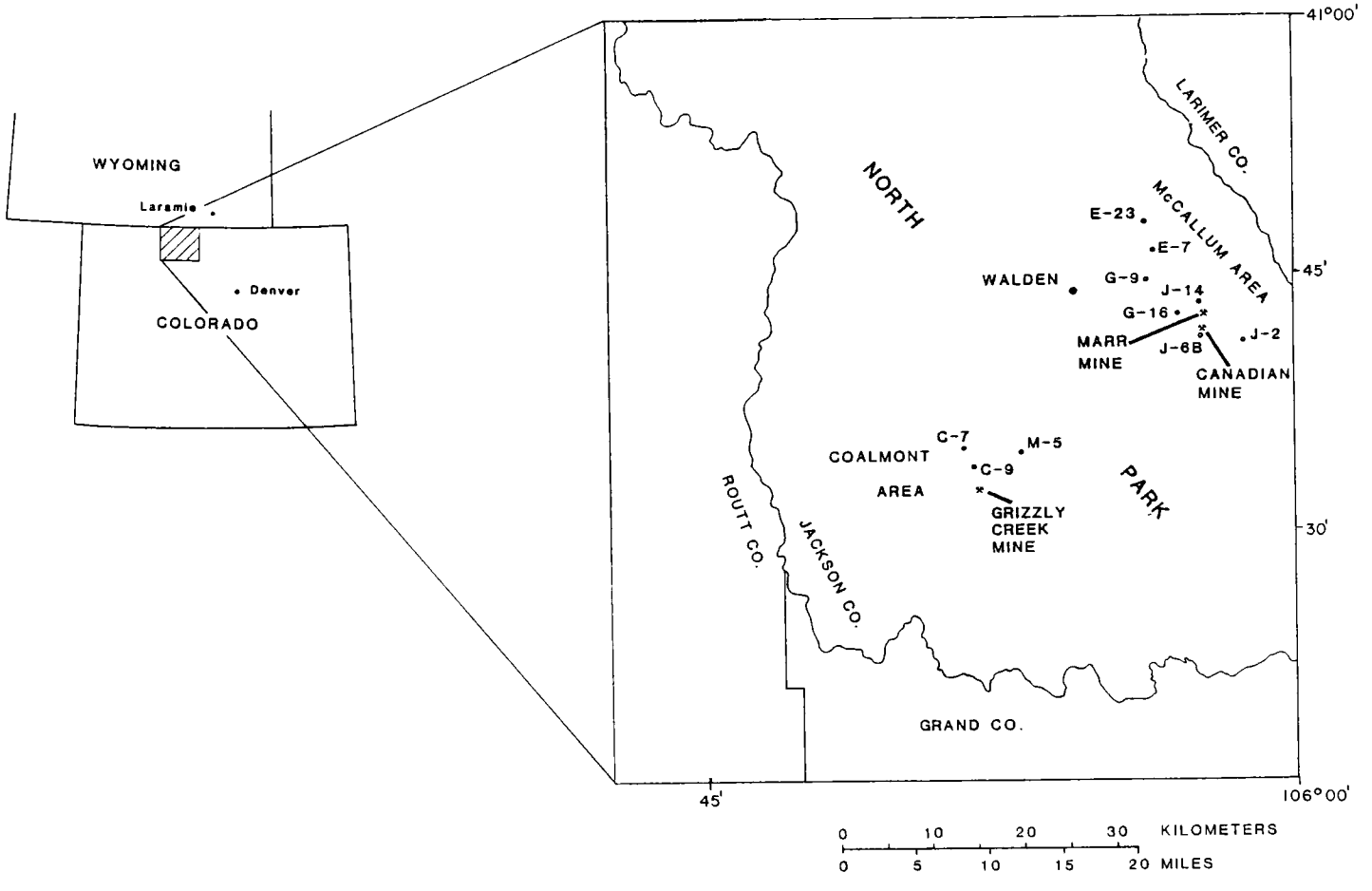


Figure C1. Index map of part of north-central Colorado showing locations of core holes (o) and mines (⚒) in North Park, Jackson County, Colorado. The margins of North Park coincide with the Jackson County line.

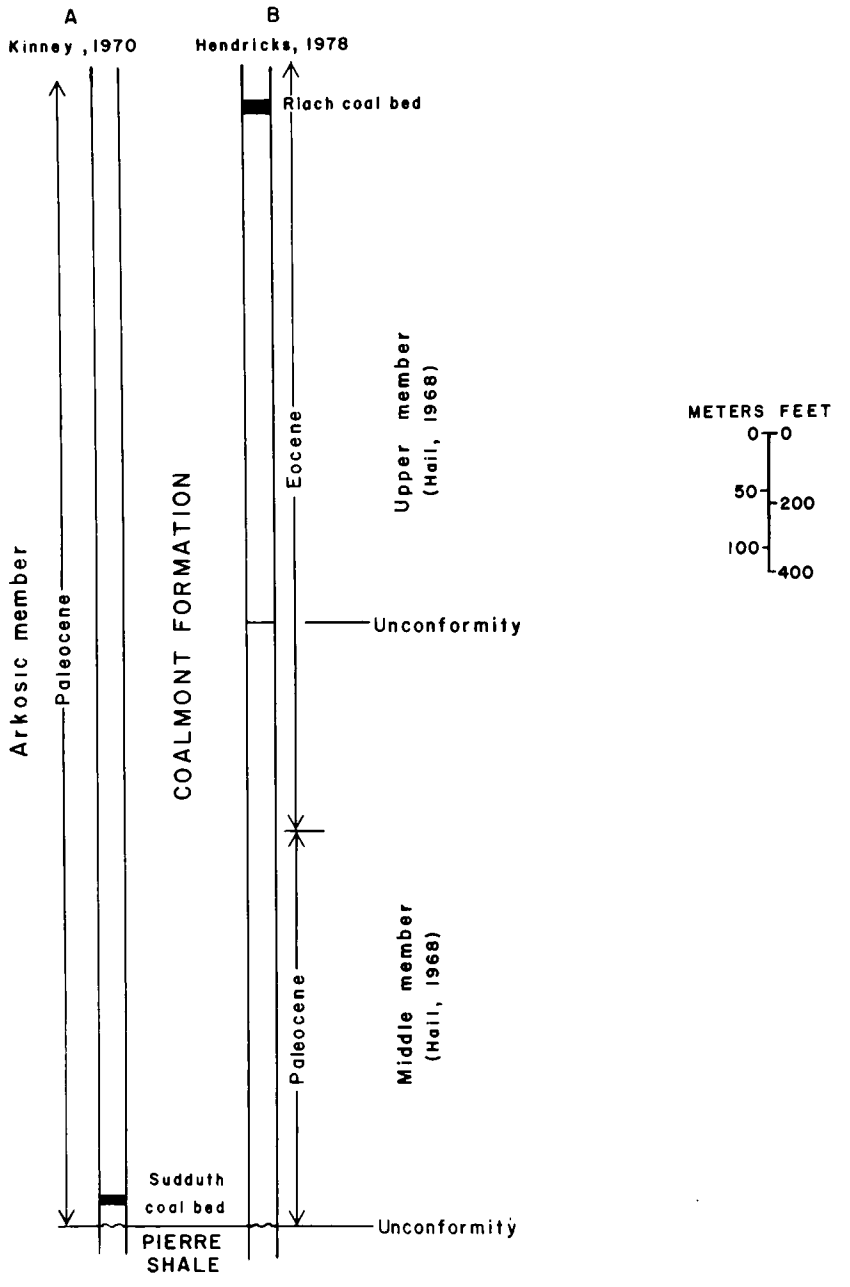


Figure C2. Generalized columnar sections of the Coalmont Formation showing stratigraphic positions of the two major coal beds in Jackson County, Colorado: A, Sudduth coal bed in McCallum area; B, Riach coal bed in Coalmont area.

exposed "outcrop" of the Riach bed in a number of places (Madden and others, 1978). In the McCallum area the Sudduth coal bed is folded into synclines and anticlines and dips range from 20° to vertical. Only minor faults cut the Sudduth bed.

According to Beekly (1915) the Sudduth bed has a maximum thickness of 58 ft, though in 1977 a thickness of 80 ft was reported in the Marr mine. The known areal extent of the coal bed (including eroded areas along anticlinal cores) is approximately 140 mi^2. The Riach bed is a maximum of 80 ft thick (Erdmann, 1941). Its known areal extent is approximately 50 mi^2. However, as suggested by subsurface data from one drill hole approximately 4 mi northeast of the immediate Coalmont area (Madden and others 1978), this areal extent may be greater.

Explanation of data and summary tables

Proximate and ultimate analyses, heat-of-combustion, air-dried-loss, forms-of-sulfur, free-swelling-index, and ash-fusion-temperature determinations on 22 McCallum area coal samples are listed in table C2. Similar analyses for 12 Coalmont area coal samples are listed in table C6. These analyses were provided by the U.S. Department of Energy, Pittsburgh, PA. Analyses for ash content and contents of 33 major and minor oxides and trace elements in the laboratory ash (table C3) and analyses for contents of seven trace elements in whole coal and coal-associated rock (table C4) for 28 McCallum area samples were provided by the U.S. Geological Survey, Denver, Colo. Similar analyses for the 16 Coalmont area samples are listed in tables C7 and C8. Analytical procedures used by the U.S. Geological Survey are described in Swanson and Huffman (1976). Table contains the data listed in table C3 converted to a whole-coal and whole-rock basis plus the analyses listed in table C4; table C9 contains the data listed in table C7 converted to a whole-coal and whole-rock basis plus the analyses listed in table C8. Twenty-five additional elements not listed in tables C3 through C9 were looked for in all samples, but not found in amounts greater than their lower limits of detection (table C10). Unweighted statistical summaries of analytical data for the 21 Sudduth bed coal samples listed in tables C2, C3, and C5, are listed in tables C11, C12, and C13, respectively; unweighted statistical summaries of analytical data for the 12 Riach bed coal samples listed in tables C6, C7, and C9 are listed in tables C14, C15, and C16, respectively. Data summaries for Cd were not included in tables C13 and C16 because this element was not detected in a sufficient number of samples to calculate meaningful statistics. Data summaries for P_2O_5 content in the Riach bed ash (table C15 and P content in coal from the Riach bed (table C16) were also not included as statistics because of the variable lower detection limits.

Arsenic content of samples summarized in this report have been determined by two different analytical methods: samples D170627 through D170637, D172052 through D172059, D174481, and D174483 through D174486 were analyzed by spectrophotometrically (lower detection limit 1.0 ppm); the other 26 samples were analyzed by instrumental neutron activation analysis (lower detection limit 0.1 ppm).

Thorium contents of the samples were determined by two methods: Samples D170627 through D170631, D172052 through D172059, D174481, and D174483 through D174486 were analyzed by delayed neutron activation

analysis (lower detection limit 3.0 ppm); the other 26 samples were analyzed by instrumental neutron activation analysis (lower detection limit 0.1 ppm).

P_2O_5 contents for all samples were determined by X-ray flourescence spectroscopy. However, due to changes in technique, the lower detection limit for samples D170627 through D170631, D172052 through D172059, D174481, and D174483 through D174486 is 0.1 percent in the ash; for samples D194452 through D194464 and D194485 through D194488 it is 1.0 percent in the ash; and for samples D196200 through D196210 and D196441 through D196444 it is 0.01 percent in whole coal.

To be consistent with the precision of the semiquantitative emmission spectrographic technique, arithmetic and geometric means of elements determined by this method are reported as the midpoint of the enclosing six-step brackets (see subtitle of table C3, or Swanson and Huffman, 1976, p. 6 for an explanation of six-step brackets.)

Analyses of 18 coal samples (D170627 through D170631, D172052 through D172059, D174481, and D174483 through D174486) listed in this report have been previously published in Swanson and others (1976, tables 37b, c, d, and e) and in Boreck and others (1977, tables 2, 3, 4, 5, and 6). We have included the analyses here in order to provide a more complete data listing.

Discussion

The apparent ranks of all coal samples from the Coalmont Formation, McCallum and Coalmont areas, were calculated using the data in tables C2 and C6 and the formulas in ASTM designation D-388-77 (American Society for Testing and Materials, 1978): Apparent rank for samples from the McCallum area ranges from subbituminous B (seven samples) to subbituminous A coal (15 samples). The samples of subbituminous A coal are from the southern part of the area and include all samples from the Marr and Canadian strip mines and cores J-14 and J-6B. Apparent rank for samples from the Coalmont area ranges from subbituminous C (one sample) to subbituminous B coal (11 samples).

A statistical comparison (student's t test 95-percent confidence level) of the data for the Sudduth and Riach beds summarized in tables 11 and 14, respectively, shows that the Sudduth bed has significantly higher contents of fixed carbon and carbon, a significantly higher heat of combustion; and significantly lower contents of moisture, ash, oxygen, and total, sulfate, pyritic and organic sulfur. The ash-fusion-temperature determinations and the contents of volatile matter, hydrogen and nitrogen are not significantly different. When compared at the 99-percent confidence level the contents of oxygen and sulfate sulfur are not significantly different.

A statistical comparison of the geometric mean contents of coal ash and the geometric mean contents of nine major and minor oxides in the ash from the Sudduth bed with the Riach bed show that the Sudduth bed ash has

a significantly lower ash content and contents of MgO, K_2O, and Fe_2O_3 in ash. The contents of SiO_2, Al_2O_3, Na_2O, TiO_2, and SO_3 in ash are not significantly different. When compared at the 99-percent confidence level the contents of CaO are not significantly different.

A statistical comparison of the geometric mean contents of 36 elements in the Sudduth bed with the Riach bed shows that the Sudduth bed has significantly lower contents of Si, Al, Mg, Na, K, Fe, Ti, Ba, Be, Co, Cr, Cu, F, Ga, La, Mn, Mo, Nb, Ni, Pb, Sc, Sr, Th, U, V, Y, Yb, and Zn. The contents of Ca, As, B, Hg, Li, Sb, Se, and Zr are not significantly different. When compared at the 99 percent confidence level the contents of Si, Na, Ti, Ga, Nb, and Pb are not significantly different.

Differences in the oxide composition of coal ashes and the elemental contents of coal result from differences in the total and relative amounts of the various inorganic minerals, the elemental composition of these minerals, and the total and relative amounts of any organically bound elements. The chemical form and distribution of a given element are dependent on the geologic history of the coal bed. A partial listing of the geologic factors that influence element distributions would include chemical composition of original plants; amounts and compositions of the various detrital, diagenetic, and epigenetic minerals; chemical characteristics of the ground waters that come in contact with the bed; temperatures and pressures during burial; and extent of weathering. No evaluation of these factors has been made for coal from the Sudduth and Riach beds.

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Table C1.

USGS sample number, mine name or hole number, location, sample thickness or depth interval and coal bed name or description for 44 coal and coal-associated rock samples from the Coalmont Formation, McCallum and Coalmont areas, North Park, Jackson County, Colo.

[McCallum area samples are of Paleocene age; Coalmont area samples are of Eocene age. One foot = 0.305 meters]

USGS sample number	Mine name or core hole number	Location	Sample thickness or depth interval in feet	Coal bed name or description
		McCallum area channel samples		
D170627	Canadian strip mine	NE¼SW¼ sec. 2, T. 8 N., R. 78 W.	top 5.0	Sudduth.
D170628	------do------	----------do----------	next 5.0	Do.
D170629	------do------	----------do----------	----do---	Do.
D170630	------do------	----------do----------	----do---	Do.
D170631	------do------	----------do----------	bottom 4.5	Do.
D172059	------do------	----------do----------	2.0	Unnamed 32 ft below Sudduth.
D172052	Marr strip mine	SW¼SE¼ sec. 26, T. 9 N., R. 78 W.	top 10.0	Sudduth.
D172053	----do----	----------do----------	---do---	Do.
D172054	----do----	----------do----------	---do---	Do.
D172055	----do----	----------do----------	---do---	Do.
D172056	----do----	----------do----------	---do---	Do.
D172057	----do----	----------do----------	---do---	Do.
D172058	----do----	----------do----------	bottom 10.0	Do.
		McCallum area core samples		
D196200	G-9	NE¼NE¼ sec. 19, T. 9 N., R. 78 W.	94.0-141.0	Sudduth.
D196201	---do---	----------do----------	142.2-148.5	Do.
D196202	J-6B	NW¼NW¼ sec. 11, T. 8 N., R. 78 W.	57.4- 71.3	Do.
D196203	J-14	NE¼SW¼ sec. 26, T. 9 N., R. 78 W.	72.9-116.0	Do.
D196204	---do---	----------do----------	116.0-153.1	Do.
D196205	E-7	C NW¼ sec. 8, T. 9 N., R. 78 W.	1641.-206.C	Do.
D196206	G-16	SE¼NE¼ sec. 33, T. 9 N., R. 78 W.	143.8-167.9	Do.
D196441	---do---	----------do----------	167.9-170.0	Mudstone, carbonaceous.
D196442	J-2	SW¼NW¼ sec. 8, T. 8 N., R. 77 W.	57.8- 61.2	Mudstone.
D196443	---do---	----------do----------	61.2- 61.8	Shale, carbonaceous.
D196207	---do---	----------do----------	61.8- 83.1	Sudduth.
D196444	---do---	----------do----------	83.1- 87.0	Mudstone.

Table C1. (cont.)

USGS sample number, mine name or hole number, location, sample thickness or depth interval and coal bed name or description for 44 coal and coal-associated rock samples from the Coalmont Formation, McCallum and Coalmont areas, North Park, Jackson County, Colo.--Continued

USGS sample number	Mine name or core hole number	Location	Sample thickness or depth interval in feet	Coal bed name or description
		McCallum area core samples--Continued		
D196208	E-23	NW¼NE¼ sec. 31, T. 10 N., R. 78 W.	189.0-190.0	Unnamed rider coal, shaley.
D196209	---do---	---do---	198.7-217.0	Sudduth.
D196210	---do---	---do---	218.4-218.9	Lower split of Sudduth, shaley.
		Coalmont area channel samples		
D174481	Grizzly Creek strip mine	SE¼NW¼ sec. 32, T. 7 N., R. 80 W.	Top 5.0	Riach.
D174483	------do-----	---do---	next 5.0	Do.
D174484	------do-----	---do---	----do----	Do.
D174485	------do-----	---do---	----do----	Do.
D174486	------do-----	---do---	bottom 3.0	Do.
		Coalmont area core samples		
D194458	C-9	SW¼SE¼ sec. 19, T. 7 N., R. 80 W.	410.0-423.0	Riach.
D194485	---do---	---do---	423.0-431.0	Clay.
D194486	C-7	NW¼SW¼ sec. 18, T. 7 N., R. 80 W.	300.0-308.5	Mudstone, carbonaceous.
D194459	---do---	---do---	308.5-312.6	Riach.
D194460	---do---	---do---	312.6-319.6	Do.
D194461	---do---	---do---	319.6-329.0	Do.
D194462	---do---	---do---	329.0-337.5	Do.
D194487	---do---	---do---	337.5-338.6	Shale, coaly.
D194463	M-5	SE¼SE¼ sec. 15, T. 7 N., R. 80 W.	710.0-723.5	Riach.
D194488	---do---	---do---	723.5-724.3	Mudstone, carbonaceous.
D194464	---do---	---do---	724.3-732.5	Riach.

Table C2.

Proximate and ultimate analyses, and heat-of-combustion, forms-of-sulfur, free-swelling index; and ash-fusion-temperature determinations for 22 coal samples from the Coalmont Formation in the McCallum area, North Park, Jackson County, Colo.

[All analyses except heat-of-combustion, free-swelling index, and ash-fusion temperatures in percent. For each sample number, the analyses are reported three ways: first, as received; second, moisture free; and third, moisture and ash free. All analyses by Coal Analysis Section, U.S. Department of Energy, Pittsburgh, Pa. °F = (°C x 1.8) + 32; Kcal/kg = 0.556 (Btu/lb). L, less than the value shown]

Sample number	Proximate analysis				Ultimate analysis					Heat of combustion	
	Moisture	Volatile matter	Fixed carbon	Ash	Hydrogen	Carbon	Nitrogen	Oxygen	Sulfur	Kcal/kg	Btu/lb
D170627	14.5	31.9	47.2	6.4	5.8	61.5	1.0	25.1	0.2	5,960	10,730
	---	37.3	55.2	7.5	4.9	71.9	1.2	14.3	.2	6,970	12,550
	---	40.3	59.7	---	5.3	77.7	1.3	15.4	.3	7,540	13,570
D170628	15.4	32.9	48.5	3.2	5.9	63.5	1.0	26.2	.2	6,110	10,990
	---	38.9	57.3	3.8	5.0	75.1	1.2	14.8	.2	7,220	12,990
	---	40.4	59.6	---	5.1	78.0	1.2	15.4	.2	7,500	13,500
D170629	16.1	31.4	43.0	9.5	5.7	57.0	.8	26.8	.2	5,500	9,900
	---	37.4	51.3	11.3	4.7	67.9	1.0	14.9	.2	6,560	11,800
	---	42.2	57.8	---	5.3	76.6	1.1	16.8	.3	7,390	13,310
D170630	14.6	32.6	49.1	3.7	5.8	63.1	.9	26.3	.2	6,050	10,890
	---	38.2	57.5	4.3	4.9	73.9	1.1	15.6	.2	7,080	12,750
	---	39.9	60.1	---	5.1	77.2	1.1	16.3	.2	7,410	13,330
D170631	14.5	27.4	38.9	19.2	5.0	49.9	.6	25.1	.2	4,770	8,580
	---	32.0	45.5	22.5	4.0	58.4	.7	14.3	.2	5,580	10,040
	---	41.3	58.7	---	5.1	75.3	.9	18.4	.3	7,190	12,940
D172059	12.8	37.3	44.8	5.1	5.9	62.9	1.0	24.4	.7	6,200	11,160
	---	42.8	51.4	5.8	5.1	72.1	1.1	14.9	.8	7,110	12,800
	---	45.4	54.6	---	5.5	76.6	1.2	15.9	.9	7,550	13,590
D172052	14.2	35.4	48.3	2.1	5.9	64.3	1.0	26.5	.2	6,270	11,280
	---	41.3	56.3	2.4	5.0	74.9	1.2	16.2	.2	7,300	13,150
	---	42.3	57.7	---	5.2	76.8	1.2	16.6	.2	7,490	13,480
D172053	14.4	34.4	47.9	3.3	5.8	62.8	.9	27.0	.2	6,020	10,830
	---	40.2	56.0	3.9	4.9	73.4	1.1	16.6	.2	7,030	12,650
	---	41.8	58.2	---	5.1	76.3	1.1	17.3	.2	7,310	13,160
D172054	13.0	35.0	47.8	4.2	5.7	63.1	.8	25.9	.3	6,060	10,900
	---	40.2	54.9	4.8	4.9	72.5	.9	16.5	.3	6,960	12,530
	---	42.3	57.7	---	5.1	76.2	1.0	17.3	.4	7,310	13,160
D172055	12.4	34.9	41.9	10.8	5.5	58.0	.7	24.8	.2	5,580	10,040
	---	39.8	47.8	12.3	4.7	66.2	.8	15.7	.2	6,370	11,460
	---	45.4	54.6	---	5.4	75.5	.9	17.9	.3	7,260	13,070
D172056	11.0	37.1	41.5	10.4	5.6	59.1	.8	23.9	.2	5,720	10,290
	---	41.7	46.6	11.7	4.9	66.4	.9	15.9	.2	6,420	11,560
	---	47.2	52.8	---	5.6	75.2	1.0	18.0	.3	7,270	13,090
D172057	12.0	36.0	45.5	6.5	5.7	61.7	.9	24.9	.3	5,990	10,790
	---	40.9	51.7	7.4	5.0	70.1	1.0	16.2	.3	6,810	12,260
	---	44.2	55.8	---	5.4	75.7	1.1	17.5	.4	7,360	13,240

Table C2. (cont.)

Proximate and ultimate analyses, and heat-of-combustion, forms-of-sulfur, free-swelling index; and ash-fusion-temperature determinations for 22 coal samples from the Coalmont Formation in the McCallum area, North Park, Jackson County, Colo.--Continued

Sample number	Air-dried loss	Forms of sulfur			Free swelling	Ash fusion temperature, °C		
		Sulfate	Pyritic	Organic		Initial deformation	Softening	Fluid
D170627	7.6	0.01	0.08	0.16	0.0	1,165	1,195	1,255
	---	.01	.09	.19				
	---	.01	.10	.20				
D170628	7.5	.01	.09	.06	.0	1,155	1,180	1,245
	---	.01	.11	.07				
	---	.01	.11	.07				
D170629	9.6	.02	.05	.09	.0	1,490	1,515	1,550
	---	.02	.06	.11				
	---	.03	.07	.12				
D170630	6.9	.01L	.04	.16	.0	1,195	1,220	1,290
	---	.01L	.05	.19				
	---	.01L	.05	.20				
D170631	8.4	.01L	.07	.10	.0	1,600+	1,600+	1,600+
	---	.01L	.08	.12				
	---	.02L	.11	.15				
D172059	6.5	.02	.21	.43	.0	1,230	1,260	1,305
	---	.02	.24	.49				
	---	.02	.26	.52				
D172052	6.9	.01L	.08	.13	.0	1,120	1,150	1,175
	---	.01L	.09	.15				
	---	.01L	.10	.16				
D172053	7.5	.01L	.13	.08	.0	1,120	1,150	1,175
	---	.01L	.15	.09				
	---	.01L	.16	.10				
D172054	6.4	.01L	.16	.11	.0	1,325	1,355	1,380
	---	.01L	.18	.13				
	---	.01L	.19	.13				
D172055	5.0	.01L	.09	.12	.0	1,600+	1,600+	1,600+
	---	.01L	.10	.14				
	---	.01L	.12	.16				
D172056	4.3	.01L	.09	.13	.0	1,600+	1,600+	1,600+
	---	.01L	.10	.15				
	---	.01L	.11	.17				
D172057	4.6	.02	.10	.14	.0	1,270	1,295	1,315
	---	.02	.11	.16				
	---	.02	.12	.17				

Table C2. (cont.)

Proximate and ultimate analyses, and heat-of-combustion, forms-of-sulfur, free-swelling index; and ash-fusion-temperature determinations for 22 coal samples from the Coalmont Formation in the McCallum area, North Park, Jackson County, Colo.--Continued

Sample number	Proximate analysis				Ultimate analysis					Heat of combustion	
	Moisture	Volatile matter	Fixed carbon	Ash	Hydrogen	Carbon	Nitrogen	Oxygen	Sulfur	Kcal/kg	Btu/lb
D172058	12.0	38.3	46.0	3.7	5.9	63.8	0.9	25.4	0.3	6,200	11,160
	---	43.5	52.3	4.2	5.2	72.5	1.0	16.7	.3	7,050	12,680
	---	45.4	54.6	---	5.4	75.7	1.1	17.5	.4	7,350	13,240
D196200	20.4	29.9	43.2	6.5	5.9	55.2	.9	31.3	.2	5,210	9,380
	---	37.6	54.3	8.2	4.6	69.3	1.1	16.5	.3	6,550	11,790
	---	40.9	59.1	---	5.0	75.5	1.2	18.0	.3	7,130	12,840
D196201	16.4	30.4	37.1	16.1	5.5	49.3	.9	27.6	.6	4,790	8,620
	---	36.4	44.4	19.3	4.4	59.0	1.1	15.6	.7	5,730	10,310
	---	45.0	55.0	---	5.4	73.0	1.3	19.3	.9	7,100	12,770
D196202	14.8	32.2	46.6	6.4	5.7	60.6	1.1	26.0	.2	5,840	10,510
	---	37.8	54.7	7.5	4.8	71.1	1.3	15.1	.2	6,850	12,330
	---	40.9	59.1	---	5.1	76.9	1.4	16.3	.3	7,410	13,340
D196203	14.0	33.3	47.2	5.5	5.7	61.3	.9	26.3	.3	5,810	10,460
	---	38.7	54.9	6.4	4.8	71.3	1.0	16.1	.3	6,760	12,170
	---	41.4	58.6	---	5.1	76.1	1.1	17.2	.4	7,220	13,000
D196204	12.9	34.4	45.7	7.0	5.6	60.5	.8	25.8	.3	5,770	10,380
	---	39.5	52.5	8.0	4.8	69.5	.9	16.5	.3	6,620	11,920
	---	42.9	57.1	---	5.2	75.5	1.0	17.9	.4	7,200	12,960
D196205	18.1	31.5	42.5	7.9	5.9	54.9	.8	30.2	.3	5,290	9,520
	---	38.5	51.9	9.6	4.7	67.0	1.0	17.2	.4	6,460	11,630
	---	42.6	57.4	---	5.3	74.2	1.1	19.1	.4	7,150	12,870
D196206	17.9	28.7	41.8	11.6	5.4	53.3	.8	28.5	.3	5,040	9,070
	---	35.0	50.9	14.1	4.2	64.9	1.0	15.3	.4	6,140	11,050
	---	40.7	59.3	---	4.8	75.6	1.1	17.9	.4	7,150	12,870
D196207	14.9	30.6	42.4	12.1	5.3	55.3	.9	26.0	.3	5,250	9,450
	---	36.0	49.8	14.2	4.3	65.0	1.1	15.0	.4	6,170	11,110
	---	41.9	58.1	---	5.0	75.8	1.2	17.5	.4	7,190	12,950
D196209	20.7	31.8	38.1	9.4	5.9	51.5	1.5	31.2	.5	5,000	8,990
	---	40.1	48.0	11.9	4.5	64.9	1.9	16.1	.6	6,300	11,340
	---	45.5	54.5	---	5.2	73.7	2.1	18.3	.7	7,150	12,870

Table C2. (cont.)

Proximate and ultimate analyses, and heat-of-combustion, forms-of-sulfur, free-swelling index; and ash-fusion-temperature determinations for 22 coal samples from the Coalmont Formation in the McCallum area, North Park, Jackson County, Colo.--Continued

Sample number	Air-dried loss	Forms of sulfur			Free swelling	Ash fusion temperature, °C		
		Sulfate	Pyritic	Organic		Initial deformation	Softening	Fluid
D172058	4.6	0.02	0.08	0.19	0.0	1,205	1,240	1,295
	---	.02	.09	.22				
	---	.02	.09	.23				
D196200	3.2	.03	.04	.12	.0	1,145	1,165	1,230
	---	.04	.05	.15				
	---	.04	.05	.16				
D196201	2.5	.01L	.04	.59	.0	1,600+	1,600+	1,600+
	---	.01L	.05	.71				
	---	.01L	.06	.87				
D196202	2.8	.01L	.06	.18	.0	1,205	1,225	1,330
	---	.01L	.07	.21				
	---	.01L	.08	.23				
D196203	2.2	.03	.07	.17	.0	1,230	1,290	1,330
	---	.03	.08	.20				
	---	.04	.09	.21				
D196204	.9	.03	.07	.20	.0	1,315	1,340	1,355
	---	.03	.08	.23				
	---	.04	.09	.25				
D196205	3.3	.01L	.07	.22	.0	1,290	1,315	1,340
	---	.01L	.09	.27				
	---	.01L	.09	.30				
D196206	3.2	.04	.09	.20	.0	1,165	1,195	1,310
	---	.05	.11	.24				
	---	.06	.13	.28				
D196207	3.4	.05	.05	.24	.0	1,260	1,290	1,345
	---	.06	.06	.28				
	---	.07	.07	.33				
D196209	3.1	.01	.08	.37	.0	1,170	1,200	1,315
	---	.01	.10	.47				
	---	.01	.11	.53				

Table C3.

Major- and minor-oxide and trace-element composition of the laboratory ash of 28 coal and shale samples from the Coalmont Formation in the McCallum area, North Park, Jackson County, Colo.

[Values in percent or parts per million. Coal and shale ashed at 525°C. L, less than the value shown; N, not detected. S after element title indicates determinations by semiquantitative emission spectrography. The spectrographic results are to be identified with geometric brackets whose boundaries are part of the ascending series 0.12, 0.18, 0.26, 0.38, 0.56, 0.83, 1.2, etc. but reported as midpoints of the brackets, 0.1, 0.15, 0.2, 0.3, 0.5, 0.7, 1.0, etc. Precision of the spectrographic data is plus-or-minus one bracket at 68 percent or plus-or-minus two brackets at 95 percent confidence level]

Sample number	Ash (percent)	SiO2 (percent)	Al2O3 (percent)	CaO (percent)	MgO (percent)	Na2O (percent)	K2O (percent)	Fe2O3 (percent)	TiO2 (percent)	P2O5 (percent)	Sample number
D170627	8.0	47	22	5.5	0.63	0.12	0.39	6.4	0.59	1.6	D170627
D170628	3.8	43	17	9.6	1.03	.15	.090	12	1.1	1.4	D170628
D170629	11.4	54	27	3.0	.93	.16	1.4	3.7	.83	.48	D170629
D170630	4.1	47	18	8.7	1.48	.11	.10	7.9	.86	.31	D170630
D170631	9.8	51	26	4.2	.93	.16	1.1	5.1	.57	1.1	D170631
D172059	6.1	34	24	8.3	1.19	.27	.15	7.5	.85	.10L	D172059
D172052	2.7	26	15	21	1.39	.20	.13	7.1	.81	1.6	D172052
D172053	2.7	16	18	22	1.81	.27	.22	7.0	.74	.53	D172053
D172054	5.4	25	26	13	1.28	.18	.16	4.6	1.6	1.1	D172054
D172055	9.5	41	30	7.3	.56	.11	.14	2.2	1.6	.93	D172055
D172056	9.2	46	24	7.4	.76	.09	.13	3.2	1.8	.53	D172056
D172057	8.1	44	26	8.3	.78	.14	.31	3.7	1.4	.35	D172057
D172058	3.9	30	18	15	1.19	.16	.13	6.9	.98	.13	D172058
D196200	7.4	33	23	12	1.82	5.10	.10	6.0	1.6	.41	D196200
D196201	19.1	54	28	3.2	.46	2.12	.30	1.6	1.2	.050	D196201
D196202	8.2	51	21	6.3	.92	.25	.80	6.5	1.0	1.1	D196202
D196203	6.4	41	21	11	1.32	.27	.70	3.9	1.1	1.1	D196203
D196204	8.7	49	24	7.8	.73	.16	.20	2.1	1.1	1.0	D196204
D196205	9.7	40	22	10	2.24	1.21	.30	4.7	1.1	.72	D196205
D196206	13.1	56	18	9.6	1.00	1.34	.60	3.2	1.0	.38	D196206
D196441	57.3	67	21	1.0	1.50	.98	2.5	2.9	.80	.12	D196441
D196442	92.8	75	19	.80	1.01	.48	2.7	2.3	.70	.080	D196442
D196443	70.2	67	28	.80	.89	.23	1.8	1.9	1.0	.060	D196443
D196207	13.2	56	22	5.4	.72	.31	.40	2.8	1.5	.38	D196207
D196444	89.3	81	17	.30	.69	.18	1.6	1.1	1.2	.060	D196444
D196208	45.3	51	25	1.5	.86	.28	1.3	11	1.2	.070	D196208
D196209	10.5	38	17	12	2.46	1.80	.30	4.4	1.0	1.9	D196209
D196210	40.8	52	21	1.7	.44	.62	.30	12	.80	.020	D196210

Table C3. (cont.)

Major- and minor-oxide and trace-element composition of the laboratory ash of 28 coal and shale samples from the Coalmont Formation in the McCallum area, North Park, Jackson County, Colo.--Continued

Sample number	SO3 (percent)	B-S (ppm)	Ba-S (ppm)	Be-S (ppm)	Cd (ppm)	Co-S (ppm)	Cr-S (ppm)	Cu (ppm)	Ga-S (ppm)	La-S (ppm)	Sample number
D170627	3.5	500	3,000	N	1.0L	7	15	44	20	N	D170627
D170628	7.1	700	5,000	N	1.0L	7	20	98	15	N	D170628
D170629	2.5	300	2,000	N	1.0L	10	30	76	15	N	D170629
D170630	7.2	1,000	5,000	3	1.0L	15	20	112	15	70	D170630
D170631	3.2	500	2,000	N	1.0L	7	10	33	15	N	D170631
D172059	8.5	1,000	1,500	7	1.0L	10	30	132	30	100	D172059
D172052	14	1,000	7,000	N	1.0L	15	30	150	20	100L	D172052
D172053	8.1	700	5,000	3	1.0L	15	20	110	30	150	D172053
D172054	5.4	300	3,000	3	1.0L	15	20	126	30	100	D172054
D172055	5.2	200	1,500	3	1.0L	15	15	68	50	100	D172055
D172056	5.1	200	1,000	N	1.0L	10L	15	106	30	100L	D172056
D172057	6.0	300	1,500	N	1.0L	15	15	102	50	100L	D172057
D172058	11	700	3,000	3	1.0L	20	30	176	30	100L	D172058
D196200	9.8	1,500	3,000	5	1.0L	10	30	96	70	150	D196200
D196201	5.2	700	1,000	10	1.0	20	70	188	100	100	D196201
D196202	7.0	1,500	3,000	3	1.0L	15	30	100	70	70	D196202
D196203	9.0	500	2,000	N	1.0L	10	30	82	70	70	D196203
D196204	8.0	500	2,000	5	1.0L	10	30	80	50	100	D196204
D196205	9.5	2,000	1,000	7	1.0L	30	50	103	70	100	D196205
D196206	6.0	700	1,500	3	1.0L	10L	20	44	50	N	D196206
D196441	.70	150	700	N	1.0L	10L	500	47	50	N	D196441
D196442	.30	100	2,000	N	1.0L	10	70	47	50	70	D196442
D196443	.90	70	2,000	5	1.0L	N	15	29	70	N	D196443
D196207	6.0	700	1,500	3	1.0L	10L	30	96	50	N	D196207
D196444	.080L	70	1,000	N	1.0L	N	50	24	50	N	D196444
D196208	3.2	300	300	5	1.0L	10L	30	58	100	70	D196208
D196209	12	1,500	1,500	7	1.0L	15	50	114	70	70	D196209
D196210	3.5	300	200	15	4.0	20	30	138	70	N	D196210

Table C3. (cont.)

Major- and minor-oxide and trace-element composition of the laboratory ash of 28 coal and shale samples from the Coalmont Formation in the McCallum area, North Park, Jackson County, Colo.--Continued

Sample number	Li (ppm)	Mn (ppm)	Mo-S (ppm)	Nb-S (ppm)	Ni-S (ppm)	Pb (ppm)	Sc-S (ppm)	Sr-S (ppm)	V-S (ppm)	Y-S (ppm)	Sample number
D170627	38	150L	5	N	15	25	10	2,000	50	20	D170627
D170628	34	740	5	N	15	25	10	2,000	70	30	D170628
D170629	32	150	5	N	10	65	10	700	100	20	D170629
D170630	29	220	10	7	20	40	15	1,500	100	30	D170630
D170631	20	150L	7	7	7	55	7	1,000	50	30	D170631
D172059	37	150L	20	20	30	50	15	500	150	50	D172059
D172052	34	150L	10	20	30	35	15	1,500	100	50	D172052
D172053	70	620	7	20L	30	40	15	1,000	100	30	D172053
D172054	138	150L	7	20L	15	50	15	700	70	30	D172054
D172055	175	150L	7	30	10L	60	15	1,000	100	30	D172055
D172056	68	150L	7	30	10L	50	10	700	150	20	D172056
D172057	69	150L	7	50	15	35	15	1,000	100	30	D172057
D172058	37	770	7	20L	30	40	15	700	150	30	D172058
D196200	145	310	15	20	15	65	20	3,000	150	70	D196200
D196201	132	80	15	20	20	65	20	1,000	150	70	D196201
D196202	44	360	15	30	30	55	15	1,500	150	50	D196202
D196203	109	480	N	20	15	40	15	1,000	150	30	D196203
D196204	170	480	7	30	15	75	20	1,000	150	50	D196204
D196205	105	420	15	20	30	45	15	1,500	150	50	D196205
D196206	42	540	N	30	10	45	10	1,000	70	30	D196206
D196441	33	230	7	30	20	55	15	500	100	30	D196441
D196442	39	150	N	20L	30	25L	15	300	150	30	D196442
D196443	84	185	N	20	N	60	15	300	70	30	D196443
D196207	105	420	N	20	20	35	15	1,000	100	30	D196207
D196444	45	82	N	20	10	25L	15	200	100	30	D196444
D196208	56	210	30	30	15	30	15	300	70	30	D196208
D196209	79	650	20	30	30	40	30	3,000	150	70	D196209
D196210	130	115	15	30	50	60	15	300	100	50	D196210

Table C3. (cont.)

Major- and minor-oxide and trace-element composition of the laboratory ash of 28 coal and shale samples from the Coalmont Formation in the McCallum area, North Park, Jackson County, Colo.--Continued

Sample number	Yb-S (ppm)	Zn (ppm)	Zr-S (ppm)
D170627	2	60	150
D170628	3	90	200
D170629	2	62	150
D170630	3	94	200
D170631	2	80	150
D172059	3	34	N
D172052	3	70	200
D172053	3	70	N
D172054	3	52	N
D172055	3	44	N
D172056	2	46	N
D172057	3	58	N
D172058	3	92	N
D196200	5	105	500
D196201	5	106	500
D196202	5	131	300
D196203	3	131	200
D196204	5	158	300
D196205	5	225	300
D196206	3	119	200
D196441	3	166	150
D196442	3	167	150
D196443	2	201	300
D196207	3	176	150
D196444	3	61	300
D196208	3	43	200
D196209	7	85	300
D196210	5	590	200

Table C4.

Content of nine trace elements in 28 coal and shale samples from the Coalmont Formation in the McCallum area, North Park, Jackson County, Colo.

[Analyses on air-dried (32°C) coal and shale. L, less than the value shown]

Sample number	As (ppm)	F (ppm)	Hg (ppm)	Sb (ppm)	Se (ppm)	Th (ppm)	U (ppm)	Sample number
D170627	1.0	115	0.04	0.1	0.5	3.0L	0.6	D170627
D170628	1.0	40	.04	.1L	.3	3.0L	.4	D170628
D170629	3.0	80	.07	.2	1.3	3.3	1.0	D170629
D170630	1.0	30	.04	.1	.3	3.0L	.4	D170630
D170631	2.0	130	.04	.1L	.3	3.0L	1.1	D170631
D172059	1.0	30	.06	.3	.4	3.4	.6	D172059
D172052	2.0	30	.02	.2	1.9	3.0L	.2L	D172052
D172053	2.0	25	.02	.2	.8	3.0L	.3	D172053
D172054	2.0	30	.01	.1	.3	3.0L	.6	D172054
D172055	2.0	35	.02	.2	1.0	4.4	.8	D172055
D172056	2.0	30	.06	.2	1.0	3.8	1.0	D172056
D172057	2.0	30	.03	.5	.4	4.6	1.3	D172057
D172058	2.0	25	.02	.2	.2	3.0L	.2L	D172058
D196200	2.7	20L	.10	.2	1.0	2.4	.5	D196200
D196201	1.9	40	.28	.3	2.7	7.7	2.7	D196201
D196202	1.9	95	.02	.1	.8	1.7	.3	D196202
D196203	1.7	50	.02	.1L	.4	1.5	.1	D196203
D196204	2.3	35	.04	.2	.1L	2.5	.5	D196204
D196205	3.0	45	.18	.2	1.1	2.5	.4	D196205
D196206	1.5	65	.03	.5	2.0	2.8	.7	D196206
D196441	10	450	.02	1.5	2.1	9.7	4.4	D196441
D196442	40	485	.04	1.6	2.3	8.6	5.3	D196442
D196443	2.1	390	.03	1.8	2.7	13	6.7	D196443
D196207	.9	60	.04	.3	1.0	3.1	.7	D196207
D196444	2.7	390	.01L	1.5	.9	10	4.6	D196444
D196208	93	120	1.20	.5	.1L	7.2	2.2	D196208
D196209	.8	50	.10	.4	1.3	2.8	.5	D196209
D196210	110	85	8.00	.9	9.6	5.8	3.4	D196210

Sample number	Zr-S (ppm)
D184639	20
D184640	20
D184641	20
D188239	200
D184642	15
D184643	50
D188240	200
D188255	10
D188256	7
D188245	150
D188246	150
D184646	20
D184645	30
D188238	150
D188254	20
D188253	30
D188237	50
D188252	10
D188236	500
D188250	70
D188251	30

Table C5.

Major-, minor-, and trace-element compoisition of 28 coal and shale samples from the Coalmont Formation in the McCallum area, North Park, Jackson County, Colo.

[Values in percent or parts per million. As, Co, Cr, F, Hg, Sb, Se, Th, and U values are from direct determinations on air-dried (32°C) coal and shale; all other values calculated from analyses of ash. S means analysis by emission spectrography; L, less than the value shown; N, not detected]

Sample number	Si (percent)	Al (percent)	Ca (percent)	Mg (percent)	Na (percent)	K (percent)	Fe (percent)	Ti (percent)	As (ppm)	B-S (ppm)	Sample number
D170627	1.8	0.95	0.32	0.030	0.007	0.026	0.36	0.028	1.0	50	D170627
D170628	.77	.34	.26	.024	.004	.003	.32	.025	1.0	30	D170628
D170629	2.9	1.6	.24	.064	.014	.14	.29	.057	3.0	30	D170629
D170630	.90	.40	.25	.037	.003	.003	.23	.021	1.0	50	D170630
D170631	2.3	1.4	.29	.055	.012	.089	.35	.033	2.0	50	D170631
D172059	.97	.76	.36	.044	.012	.008	.32	.031	1.0	70	D172059
D172052	.33	.21	.40	.023	.004	.003	.13	.013	2.0	30	D172052
D172053	.20	.26	.42	.029	.005	.005	.13	.012	2.0	20	D172053
D172054	.63	.74	.51	.042	.007	.007	.17	.052	2.0	15	D172054
D172055	1.8	1.5	.50	.032	.008	.011	.14	.089	2.0	20	D172055
D172056	2.0	1.2	.48	.042	.006	.010	.20	.099	2.0	20	D172056
D172057	1.6	1.1	.48	.038	.008	.021	.21	.066	2.0	20	D172057
D172058	.55	.37	.42	.028	.005	.004	.19	.023	2.0	30	D172058
D196200	1.1	.90	.63	.081	.28	.006	.31	.071	2.7	100	D196200
D196201	4.8	2.8	.44	.053	.30	.048	.21	.14	1.9	150	D196201
D196202	2.0	.91	.37	.045	.015	.055	.37	.049	1.9	150	D196202
D196203	1.2	.71	.50	.051	.013	.037	.17	.042	1.7	30	D196203
D196204	2.0	1.1	.48	.038	.010	.014	.13	.057	2.3	50	D196204
D196205	1.8	1.1	.69	.13	.087	.024	.32	.064	3.0	200	D196205
D196206	3.4	1.2	.90	.079	.13	.065	.29	.078	1.5	100	D196206
D196441	18	6.4	.41	.52	.42	1.2	1.2	.27	10	100	D196441
D196442	33	9.3	.53	.56	.33	2.1	1.5	.39	40	100	D196442
D196443	22	10	.40	.38	.12	1.1	.93	.42	2.1	50	D196443
D196207	3.5	1.5	.51	.057	.030	.044	.26	.12	.9	100	D196207
D196444	34	8.0	.19	.37	.12	1.2	.69	.64	2.7	70	D196444
D196208	11	6.0	.49	.23	.094	.49	3.5	.33	93	150	D196208
D196209	1.9	.94	.90	.16	.14	.026	.32	.063	.8	150	D196209
D196210	9.9	4.5	.50	.11	.19	.10	3.4	.20	110	150	D196210

Table C5. (cont.)

Major-, minor-, and trace-element composition of 28 coal and shale samples from the Coalmont Formation in the McCallum area, North Park, Jackson County, Colo.--Continued

Sample number	Ba-S (ppm)	Be-S (ppm)	Cd (ppm)	Co-S (ppm)	Cr-S (ppm)	Cu (ppm)	F (ppm)	Ga-S (ppm)	Hg (ppm)	La-S (ppm)	Sample number
D170627	200	N	0.08L	0.5	1	3.5	115	1.5	0.04	N	D170627
D170628	200	N	.04L	.3	.7	3.7	40	.7	.04	N	D170628
D170629	200	N	.11L	1	3	8.7	80	1.5	.07	N	D170629
D170630	200	.15	.04L	.7	.7	4.6	30	.7	.04	3	D170630
D170631	200	N	.10L	.7	1	3.2	130	1.5	.04	N	D170631
D172059	100	.5	.06L	.7	2	8.1	30	2	.06	7	D172059
D172052	200	N	.03L	.5	.7	4.1	30	.5	.02	3L	D172052
D172053	150	.07	.03L	.5	.5	3.0	25	.7	.02	5	D172053
D172054	150	.15	.05L	.7	1	6.8	30	1.5	.01	5	D172054
D172055	150	.3	.10L	1.5	1.5	6.5	35	5	.02	10	D172055
D172056	100	N	.09L	1L	1.5	9.8	30	3	.06	10L	D172056
D172057	150	N	.08L	1.5	1.5	8.3	30	5	.03	7L	D172057
D172058	100	.1	.04L	.7	1	6.9	25	1	.02	5L	D172058
D196200	200	.3	.07L	.7	2	7.1	20L	5	.10	10	D196200
D196201	200	2	.19	3	15	36	40	20	.28	20	D196201
D196202	200	.2	.08L	1.5	2	8.2	95	7	.02	7	D196202
D196203	150	N	.06L	.7	2	5.2	50	5	.02	5	D196203
D196204	150	.5	.09L	1	2	7.0	35	5	.04	10	D196204
D196205	100	.7	.10L	3	5	10	45	7	.18	10	D196205
D196206	200	.5	.13L	1.5L	3	5.8	65	7	.03	N	D196206
D196441	500	N	.57L	7L	300	27	450	30	.02	N	D196441
D196442	2,000	N	.93L	10	70	44	485	50	.04	70	D196442
D196443	1,500	3	.70L	N	10	20	390	50	.03	N	D196443
D196207	200	.5	.13L	1.5L	5	13	60	7	.04	N	D196207
D196444	1,000	N	.89L	N	50	21	390	50	.01L	N	D196444
D196208	150	2	.45L	5L	15	26	120	50	1.2	30	D196208
D196209	150	.7	.11L	1.5	5	12	50	7	.10	7	D196209
D196210	70	7	1.6	7	15	56	85	30	8.0	N	D196210

Table C5. (cont.)

Major-, minor-, and trace-element composition of 28 coal and shale samples from the Coalmont Formation in the McCallum area, North Park, Jackson County, Colo.--Continued

Sample number	Li (ppm)	Mn (ppm)	Mo-S (ppm)	Nb-S (ppm)	Ni-S (ppm)	P (ppm)	Pb (ppm)	Sb (ppm)	Sc-S (ppm)	Se (ppm)	Sample number
D170627	3.0	12L	0.5	N	1	570	2.0	0.1	0.7	0.5	D170627
D170628	1.3	28	.2	N	.7	230	1.0	.1L	.3	.3	D170628
D170629	3.6	17	.7	N	1	240	7.4	.2	1	1.3	D170629
D170630	1.2	9.0	.5	.3	.7	56	1.6	.1	.7	.3	D170630
D170631	2.0	15L	.7	.7	.7	450	5.4	.1L	.7	.3	D170631
D172059	2.3	9.2L	1.5	1.5	2	27L	3.1	.3	1	.4	D172059
D172052	.9	4.1L	.3	.5	.7	190	.9	.2	.5	1.9	D172052
D172053	1.9	17	.2	.5L	.7	63	1.1	.2	.5	.8	D172053
D172054	7.5	8.1L	.3	1L	.7	260	2.7	.1	.7	.3	D172054
D172055	17	14L	.7	3	1L	390	5.7	.2	1.5	1.0	D172055
D172056	6.3	14L	.7	3	1L	210	4.6	.2	1	1.0	D172056
D172057	5.6	12L	.7	5	1.5	120	2.8	.5	1.5	.4	D172057
D172058	1.4	30	.3	.7L	1	22	1.6	.2	.7	.2	D172058
D196200	11	23	1	1.5	1	130	4.8	.2	1.5	1.0	D196200
D196201	25	15	3	3	3	42	12	.3	3	2.7	D196201
D196202	3.6	30	1.5	2	2	390	4.5	.1	1.5	.8	D196202
D196203	7.0	31	N	1.5	1	310	2.6	.1L	1	.4	D196203
D196204	15	42	.7	2	1.5	380	6.5	.2	1.5	.1L	D196204
D196205	10	41	1.5	2	3	310	4.4	.2	1.5	1.1	D196205
D196206	5.5	71	N	5	1.5	220	5.9	.5	1.5	2.0	D196206
D196441	19	130	5	15	10	300	32	1.5	10	2.1	D196441
D196442	36	140	N	20L	30	320	23L	1.6	15	2.3	D196442
D196443	59	130	N	15	N	180	42	1.8	10	2.7	D196443
D196207	14	55	N	3	3	220	4.6	.3	2	1.0	D196207
D196444	40	73	N	20	10	230	22L	1.5	15	.9	D196444
D196208	25	95	15	15	7	140	14	.5	7	.1L	D196208
D196209	8.3	68	2	3	3	870	4.2	.4	3	1.3	D196209
D196210	53	47	7	15	20	36	24	.9	7	9.6	D196210

Table C5. (cont.)

Major-,minor-, and trace-element composition of 28 coal and shale samples from the Coalmont Formation in the McCallum area, North Park, Jackson County, Colo.--Continued

Sample number	Sr-S (ppm)	Th (ppm)	U (ppm)	V-S (ppm)	Y-S (ppm)	Yb-S (ppm)	Zn (ppm)	Zr-S (ppm)	Sample number
D170627	150	3.0L	0.6	5	1.5	0.15	4.8	10	D170627
D170628	70	3.0L	.4	3	1	.1	3.4	7	D170628
D170629	70	3.3	1.0	10	2	.2	7.1	15	D170629
D170630	70	3.0L	.4	5	1.5	.15	3.9	7	D170630
D170631	100	3.0L	1.1	5	3	.2	7.8	15	D170631
D172059	30	3.4	.6	10	3	.2	2.1	N	D172059
D172052	50	3.0L	.2L	3	1.5	.07	1.9	5	D172052
D172053	30	3.0L	.3	3	.7	.07	1.9	N	D172053
D172054	30	3.0L	.6	3	1.5	.15	2.8	N	D172054
D172055	100	4.4	.8	10	3	.3	4.2	N	D172055
D172056	70	3.8	1.0	15	2	.2	4.2	N	D172056
D172057	70	4.6	1.3	7	2	.2	4.7	N	D172057
D172058	30	3.0L	.2L	7	1	.1	3.6	N	D172058
D196200	200	2.4	.5	10	5	.3	7.8	30	D196200
D196201	200	7.7	2.7	30	15	1	20	100	D196201
D196202	150	1.7	.3	15	5	.5	11	20	D196202
D196203	70	1.5	.1	10	2	.2	8.4	15	D196203
D196204	100	2.5	.5	15	5	.5	14	20	D196204
D196205	150	2.5	.4	15	5	.5	22	30	D196205
D196206	150	2.8	.7	10	5	.5	16	30	D196206
D196441	300	9.7	4.4	70	15	1.5	95	100	D196441
D196442	300	8.6	5.3	150	30	3	150	150	D196442
D196443	200	13.0	6.7	50	20	1.5	140	200	D196443
D196207	150	3.1	.7	15	5	.5	23	20	D196207
D196444	200	10.0	4.6	100	30	3	54	300	D196444
D196208	150	7.2	2.2	30	15	1.5	19	100	D196208
D196209	300	2.8	.5	15	7	.7	8.9	30	D196209
D196210	150	5.8	3.4	50	20	2	240	70	D196210

Table C6.

Proximate and ultimate analyses, and heat-of-combustion, forms-of-sulfur, free-swelling-index, and ash-fusion-temperature determinations for 12 coal samples from the Riach bed, Coalmont Formation in the Coalmont area, North Park, Jackson County, Colo.

[All analyses except heat-of-combustion, free-swelling index, and ash-fusion temperatures in percent. For each sample number, the analyses are reported three ways: first, as received; second, moisture free; and third, moisture and ash free. All analyses by Coal Analysis Section, U.S. Department of Energy, Pittsburgh, Pa. °F = (°C x 1.8) + 32; Kcal/kg = 0.556 (Btu/lb), L, less the value shown]

Sample number	Proximate analysis				Ultimate analysis					Heat of combustion	
	Moisture	Volatile matter	Fixed carbon	Ash	Hydrogen	Carbon	Nitrogen	Oxygen	Sulfur	Kcal/kg	Btu/lb
D174481	14.5	29.3	24.7	31.5	4.6	37.8	0.5	25.0	0.6	3,620	6,520
	---	34.3	28.9	36.8	3.5	44.2	.6	14.2	.7	4,240	7,630
	---	54.3	45.7	---	5.5	70.0	.9	22.4	1.1	6,710	12,070
D174483	17.2	37.3	36.9	8.6	6.0	54.3	.7	29.8	.6	5,290	9,520
	---	45.0	44.6	10.4	4.9	65.6	.8	17.5	.7	6,390	11,500
	---	50.3	49.7	---	5.5	73.2	.9	19.6	.8	7,130	12,830
D174484	17.8	32.0	37.1	13.1	5.6	50.0	.7	29.6	1.0	4,780	8,600
	---	38.9	45.1	15.9	4.4	60.8	.9	16.8	1.2	5,810	10,460
	---	46.3	53.7	---	5.2	72.4	1.0	19.9	1.4	6,910	12,450
D174485	19.4	33.7	41.4	5.5	6.0	55.3	.8	31.7	.7	5,320	9,570
	---	41.8	51.4	6.8	4.8	68.6	1.0	17.9	.9	6,600	11,870
	---	44.9	55.1	---	5.1	73.6	1.1	19.2	.9	7,080	12,740
D174486	20.2	34.5	34.1	11.2	5.8	49.8	.8	31.5	.9	4,790	8,630
	---	43.2	42.7	14.0	4.5	62.4	1.0	17.0	1.1	6,010	10,810
	---	50.3	49.7	---	5.2	72.6	1.2	19.7	1.3	6,990	12,580
D194458	18.5	30.4	35.0	16.1	5.6	46.7	.9	29.4	1.2	4,480	8,060
	---	37.3	42.9	19.8	4.3	57.3	1.1	15.9	1.5	5,490	9,890
	---	46.5	53.5	---	5.4	71.4	1.4	19.8	1.8	6,840	12,320
D194459	14.7	28.0	28.7	28.6	5.2	41.9	.9	23.0	.4	4,120	7,420
	---	32.8	33.6	33.5	4.2	49.1	1.1	11.6	.5	4,830	8,700
	---	49.4	50.6	---	6.3	73.9	1.6	17.5	.7	7,270	13,090
D194460	17.3	31.8	36.9	14.0	5.7	50.1	1.2	28.7	.3	4,760	8,560
	---	38.5	44.6	16.9	4.6	60.6	1.5	16.1	.4	5,750	10,350
	---	46.3	53.7	---	5.5	72.9	1.7	19.4	.4	6,920	12,460
D194461	18.2	32.2	40.4	9.2	5.8	52.6	1.3	30.4	.7	5,030	9,060
	---	39.4	49.4	11.2	4.6	64.3	1.6	17.4	.9	6,150	11,070
	---	44.4	55.6	---	5.2	72.5	1.8	19.6	1.0	6,930	12,480
D194462	19.1	31.9	43.9	5.1	5.9	55.2	1.4	31.8	.5	5,260	9,480
	---	39.4	54.3	6.3	4.7	68.2	1.7	18.3	.6	6,510	11,710
	---	42.1	57.9	---	5.0	72.8	1.8	19.6	.7	6,950	12,500
D194463	15.7	24.5	22.8	37.0	4.3	32.2	.4	25.4	.6	3,060	5,500
	---	29.1	27.0	43.9	3.0	38.2	.5	13.6	.7	3,630	6,530
	---	51.8	48.2	---	5.4	68.1	.8	24.2	1.3	6,460	11,630
D194464	18.5	29.6	32.8	19.1	5.4	43.7	.6	29.7	1.4	4,160	7,490
	---	36.3	40.2	23.4	4.1	53.6	.7	16.3	1.7	5,110	9,190
	---	47.4	52.6	---	5.4	70.0	1.0	21.2	2.2	6,670	12,010

Table C6. (cont.)

Proximate and ultimate analyses, and heat-of-combustion, forms-of-sulfur, free-swelling-index, and ash-fusion-temperature determinations for 12 coal samples from the Riach bed, Coalmont Formation in the Coalmont area, North Park, Jackson County, Colo.--Continued

Sample number	Air-dried loss	Forms of sulfur			Free swelling	Ash fusion temperature, C		
		Sulfate	Pyritic	Organic		Initial deformation	Softening	Fluid
D174481	2.7	0.03	0.16	0.39	0.0	1,600+	1,600+	1,600+
	---	.04	.19	.46				
	---	.06	.30	.72				
D174483	2.5	.01	.15	.42	.0	1,230	1,290	1,345
	---	.01	.18	.51				
	---	.01	.20	.57				
D174484	2.4	.09	.36	.52	.0	1,350	1,380	1,410
	---	.11	.44	.63				
	---	.13	.52	.75				
D174485	3.8	.04	.24	.46	.0	1,125	1,150	1,170
	---	.05	.30	.57				
	---	.05	.32	.61				
D174486	4.8	.07	.39	.44	.0	1,250	1,270	1,295
	---	.09	.49	.55				
	---	.10	.57	.64				
D194458	11.0	.04	.54	.64	.0	1,180	1,215	1,290
	---	.05	.66	.79				
	---	.06	.83	.98				
D194459	9.9	.02	.11	.31	.0	1,540	1,540	1,540
	---	.02	.13	.36				
	---	.04	.19	.55				
D194460	7.7	.01	.02	.25	.0	1,380	1,410	1,530
	---	.01	.02	.30				
	---	.01	.03	.36				
D194461	5.7	.08	.28	.37	.0	1,170	1,230	1,350
	---	.10	.34	.45				
	---	.11	.39	.51				
D194462	7.4	.01	.07	.38	.0	1,145	1,175	1,280
	---	.01	.09	.47				
	---	.01	.09	.50				
D194463	6.4	.06	.18	.32	.0	1,600+	1,600+	1,600+
	---	.07	.21	.38				
	---	.13	.38	.68				
D194464	7.0	.26	.58	.60	.0	1,165	1,230	1,345
	---	.32	.71	.74				
	---	.42	.93	.96				

Table C7.

Major- and minor-oxide and trace-element composition of the laboratory ash of 16 coal and shale samples from the Riach bed, Coalmont Formation in the Coalmont area, North Park, Jackson County, Colo.

[Values in percent or parts per million. Coal and shale ashed at 525°C. L, less than the value shown; N, not detected. S after element title indicates determinations by semiquantitative emission spectrography. The spectrographic results are to be identified with geometric brackets whose boundaries are part of the ascending series 0.12, 0.18, 0.26, 0.38, 1.2, etc. but reported as midpoints of the brackets, 0.1, 0.15, 0.2, 0.3, 0.5, 0.7, 1.0, etc. Precision of the spectrographic data is plus-or-minus one bracket at 68 percent or plus-or-minus two brackets at 95 percent confidence level]

Sample number	Ash (percent)	SiO2 (percent)	Al2O3 (percent)	CaO (percent)	MgO (percent)	Na2O (percent)	K2O (percent)	Fe2O3 (percent)	TiO2 (percent)	P2O5 (percent)	Sample number
D174481	21.5	48	26	3.1	1.18	0.11	1.8	5.4	1.0	0.22	D174481
D174483	8.9	32	22	11	1.53	.12	.91	6.3	.96	.58	D174483
D174484	12.9	37	22	7.0	1.09	.09	.66	9.5	.93	.25	D174484
D174485	6.2	21	15	16	2.12	.11	.40	12	.72	.31	D174485
D174486	12.9	32	22	7.8	1.49	.12	1.2	11	.95	.16	D174486
D194458	20.5	46	24	4.4	1.56	1.80	1.4	9.1	1.0	1.0L	D194458
D194485	86.7	60	20	.91	1.70	.64	2.4	10	.84	1.0L	D194485
D194486	78.2	63	27	.43	1.40	.56	1.9	4.5	1.2	1.0L	D194486
D194459	13.8	46	26	4.0	2.08	2.62	1.2	8.7	1.3	1.0L	D194459
D194460	15.6	46	26	3.3	1.84	2.25	1.0	7.7	1.5	1.0	D194460
D194461	12.6	45	25	3.8	2.16	2.66	.90	9.6	1.3	1.0	D194461
D194462	6.5	32	20	5.6	3.42	5.40	.60	11	1.0	2.0	D194462
D194487	54.7	61	29	.64	1.11	.65	1.6	4.3	1.3	1.0L	D194487
D194463	40.0	57	30	2.1	2.42	1.01	1.8	5.9	1.3	1.0L	D194463
D194488	87.1	64	30	.41	.95	.34	1.7	2.9	1.2	1.0L	D194488
D194464	22.0	44	22	4.2	2.04	2.00	1.0	9.7	1.1	1.0L	D194464

Sample number	SO3 (percent)	B-S (ppm)	Ba-S (ppm)	Be-S (ppm)	Cd (ppm)	Co-S (ppm)	Cr-S (ppm)	Cu (ppm)	Ga-S (ppm)	La-S (ppm)	Sample number
D174481	4.8	300	1,500	7	1.0L	30	150	216	50	100L	D174481
D174483	14	500	5,000	7	1.0L	30	150	246	30	100	D174483
D174484	11	300	1,500	5	1.0L	30	100	214	30	100L	D174484
D174485	24	700	2,000	7	1.0L	30	150	284	30	100	D174485
D174486	13	300	1,000	7	2.5	30	150	386	30	100	D174486
D194458	8.2	200	2,000	5	1.0L	50	150	310	30	100	D194458
D194485	1.2	N	500	3	1.0L	30	100	99	70	100L	D194485
D194486	.082	50L	500	N	2.0	10	100	108	30	100L	D194486
D194459	6.5	200	3,000	3	1.0L	50	200	191	70	100	D194459
D194460	3.8	150	3,000	3	1.0L	20	150	161	70	70	D194460
D194461	7.8	150	2,000	3	1.0L	50	150	182	50	150	D194461
D194462	12	300	5,000	5	1.0	50	150	215	50	150	D194462
D194487	1.1	50L	1,000	3	2.0	30	150	203	70	100	D194487
D194463	3.2	100	1,000	3	1.0L	30	150	173	50	70	D194463
D194488	.15	50L	500	3	1.0	10L	100	96	50	100L	D194488
D194464	8.2	200	1,500	7	1.0L	50	150	404	70	150	D194464

Table C7. (cont.)

Major- and minor-oxide and trace-element composition of the laboratory ash of 16 coal and shale samples from the Riach bed, Coalmont Formation in the Coalmont area, North Park, Jackson County, Colo.--Continued

Sample number	Li (ppm)	Mn (ppm)	Mo-S (ppm)	Nb-S (ppm)	Nd-S (ppm)	Ni-S (ppm)	Pb (ppm)	Sc-S (ppm)	Sr-S (ppm)	V-S (ppm)	Sample number
D174481	72	270	30	30	150L	50	40	20	1,000	300	D174481
D174483	50	1,100	50	20	150	70	30	30	3,000	300	D174483
D174484	66	550	30	20L	150L	100	30	20	1,500	200	D174484
D174485	20	1,100	70	20	150	70	40	30	3,000	300	D174485
D174486	50	850	70	20	150	70	45	30	1,000	300	D174486
D194458	75	260	50	20	N	100	65	30	1,000	300	D194458
D194485	68	1,190	7	30	150	50	40	30	150	150	D194485
D194486	72	225	7	30	150	30	25L	30	100	150	D194486
D194459	61	830	30	20	N	100	50	30	1,500	300	D194459
D194460	79	1,320	30	30	N	50	55	30	2,000	200	D194460
D194461	69	315	30	30	150	100	25	30	1,500	200	D194461
D194462	52	790	70	20	150	100	55	30	2,000	300	D194462
D194487	88	110	30	30	150	50	25	30	500	300	D194487
D194463	94	190	20	20	N	50	40	30	700	200	D194463
D194488	96	100	N	30	150	20	30	30	150	150	D194488
D194464	69	290	50	20	150	100	55	30	2,000	300	D194464

Sample number	Y-S (ppm)	Yb-S (ppm)	Zn (ppm)	Zr-S (ppm)
D174481	50	5	150	70
D174483	70	7	100	70
D174484	30	5	55	70
D174485	70	7	97	70
D174486	70	7	304	70
D194458	70	7	247	70
D194485	50	7	191	100
D194486	50	3	165	100
D194459	70	7	126	70
D194460	50	7	126	70
D194461	70	7	129	100
D194462	100	10	163	100
D194487	70	7	132	100
D194463	70	7	170	70
D194488	30	3	85	70
D194464	100	7	208	70

Table C8.

Content of seven trace elements in 16 coal and shale samples from the Riach bed, Coalmont Formation in the Coalmont area, North Park, Jackson County, Colo.

[Analyses on air-dried (32°C) coal and shale. L, less than the value shown]

Sample number	As (ppm)	F (ppm)	Hg (ppm)	Sb (ppm)	Se (ppm)	Th (ppm)	U (ppm)	Sample number
D174481	2.0	185	0.04	0.2	2.4	16	13	D174481
D174483	1.0	75	.03	.2	.7	3.0L	5.8	D174483
D174484	4.0	65	.21	.2	5.7	9.9	4.6	D174484
D174485	2.0	35	.04	.1	1.6	9.0	3.5	D174485
D174486	3.0	55	.09	.2	2.4	3.0L	10	D174486
D194458	3.0	85	.16	.1L	3.6	7.5	13	D194458
D194485	5.4	605	.12	.6	1.7	19	14	D194485
D194486	1.4	445	.08	.6	1.0	26	12	D194486
D194459	1.4	90	.09	.2	.1L	4.3	4.1	D194459
D194460	.6	90	.01	.1	.5	3.9	3.5	D194460
D194461	2.0	65	.17	.2	3.1	4.2	3.7	D194461
D194462	.8	35	.04	.1L	.7	2.0	2.2	D194462
D194487	2.4	185	.17	.9	1.9	25	18	D194487
D194463	1.2	275	.07	.2	.1L	8.9	14	D194463
D194488	.8	440	.04	.5	1.9	23	20	D194488
D194464	2.1	105	.19	.3	.1L	5.8	12	D194464

Table C9.

Major-, minor-, and trace-element composition of 16 coal and shale samples from the Riach bed, Coalmont Formation in the Coalmont area, North Park, Jackson County, Colo.

[Values in percent or parts per million. As, F, Hg, Sb, Se, Th, and U values are from direct determinations on air-dried (32°C) coal and shale; all other values calculated from analyses of ash. S means analysis by emission spectrography; L, less than the value shown; N, not detected]

Sample number	Si (percent)	Al (percent)	Ca (percent)	Mg (percent)	Na (percent)	K (percent)	Fe (percent)	Ti (percent)	As (ppm)	B-S (ppm)	Sample number
D174481	4.8	2.9	0.48	0.15	0.018	0.33	0.81	0.13	2.0	70	D174481
D174483	1.3	1.0	.69	.082	.008	.067	.39	.051	1.0	50	D174483
D174484	2.2	1.5	.64	.085	.009	.071	.86	.072	4.0	50	D174484
D174485	.61	.48	.69	.079	.005	.021	.53	.027	2.0	50	D174485
D174486	1.9	1.5	.72	.12	.011	.13	.96	.073	3.0	50	D174486
D194458	4.4	2.6	.64	.19	.27	.24	1.3	.12	3.0	50	D194458
D194485	24	9.2	.56	.89	.41	1.7	6.1	.44	5.4	N	D194485
D194486	23	11	.24	.66	.32	1.2	2.5	.56	1.4	50L	D194486
D194459	3.0	1.9	.39	.17	.27	.14	.84	.11	1.4	30	D194459
D194460	3.4	2.1	.37	.17	.26	.13	.84	.14	.6	20	D194460
D194461	2.6	1.7	.34	.16	.25	.094	.85	.098	2.0	20	D194461
D194462	.97	.69	.26	.13	.26	.032	.50	.039	.8	20	D194462
D194487	16	8.4	.25	.37	.26	.73	1.6	.43	2.4	30L	D194487
D194463	11	6.3	.60	.58	.30	.60	1.6	.31	1.2	50	D194463
D194488	26	14	.25	.50	.22	1.2	1.8	.63	.8	50L	D194488
D194464	4.5	2.6	.66	.27	.33	.18	1.5	.14	2.1	50	D194464

Sample number	Ba-S (ppm)	Be-S (ppm)	Cd (ppm)	Co-S (ppm)	Cr-S (ppm)	Cu (ppm)	F (ppm)	Ga-S (ppm)	Hg (ppm)	La-S (ppm)	Sample number
D174481	300	1.5	0.22L	7	30	46	185	10	0.04	20L	D174481
D174483	500	.7	.09L	3	15	22	75	3	.03	10	D174483
D174484	200	.7	.13L	5	15	28	65	5	.21	15L	D174484
D174485	150	.5	.06L	2	10	18	35	2	.04	7	D174485
D174486	150	1	.32	5	20	50	55	5	.09	15	D174486
D194458	500	1	.21L	10	30	64	85	7	.16	20	D194458
D194485	500	2	.87L	20	100	86	605	70	.12	100L	D194485
D194486	500	N	1.6	7	70	84	445	20	.08	70L	D194486
D194459	500	.5	.14L	7	30	26	90	10	.09	15	D194459
D194460	500	.5	.16L	3	20	25	90	10	.01	10	D194460
D194461	200	.3	.13L	7	20	23	65	7	.17	20	D194461
D194462	300	.3	.07	3	10	14	35	3	.04	10	D194462
D194487	500	1.5	1.1	15	70	110	185	30	.17	50	D194487
D194463	500	1	.40L	10	70	69	275	20	.07	30	D194463
D194488	500	3	.87	10L	100	84	440	50	.04	100L	D194488
D194464	300	1.5	.22L	10	30	89	105	15	.19	30	D194464

Table C9. (cont.)

Major-, minor-, and trace-element composition of 16 coal and shale samples from the Riach bed, Coalmont Formation in the Coalmont area, North Park, Jackson County, Colo.--Continued

Sample number	Li (ppm)	Mn (ppm)	Mo-S (ppm)	Nb-S (ppm)	Nd-S (ppm)	Ni-S (ppm)	P (ppm)	Pb (ppm)	Sb (ppm)	Sc-S (ppm)	Sample number
D174481	15	58	7	7	30L	10	210	8.6	0.2	5	D174481
D174483	4.5	98	5	2	15	7	230	2.7	.2	3	D174483
D174484	8.5	71	5	2L	20L	15	140	3.9	.2	2	D174484
D174485	1.2	68	5	1.5	10	5	84	2.5	.1	2	D174485
D174486	6.5	110	10	2	20	10	90	5.8	.2	5	D174486
D194458	15	53	10	5	N	20	900L	13	.1L	7	D194458
D194485	59	1,000	7	20	150	50	3,800L	35	.6	20	D194485
D194486	56	180	5	20	100	20	3,400L	20L	.6	20	D194486
D194459	8.4	110	5	3	N	15	600L	6.9	.2	5	D194459
D194460	12	210	5	5	N	7	680	8.6	.1	5	D194460
D194461	8.7	40	3	3	20	15	550	3.2	.2	3	D194461
D194462	3.4	51	5	1.5	10	7	570	3.6	.1L	2	D194462
D194487	48	60	15	15	70	30	2,400L	14	.9	15	D194487
D194463	38	76	7	7	N	20	1,700L	16	.2	10	D194463
D194488	84	87	N	30	150	15	3,800L	26	.5	30	D194488
D194464	15	64	10	5	30	20	960L	12	.3	7	D194464

Sample number	Se (ppm)	Sr-S (ppm)	Th (ppm)	U (ppm)	V-S (ppm)	Y-S (ppm)	Yb-S (ppm)	Zn (ppm)	Zr-S (ppm)	Sample number
D174481	2.4	200	16.1	13	70	10	1	32	15	D174481
D174483	.7	300	3.0L	5.8	30	7	.7	8.9	7	D174483
D174484	5.7	200	9.9	4.6	20	5	.7	7.1	10	D174484
D174485	1.6	200	9.0	3.5	20	5	.5	6.0	5	D174485
D174486	2.4	150	3.0L	10	50	10	1	39	10	D174486
D194458	3.6	200	7.5	13	70	15	1.5	51	15	D194458
D194485	1.7	150	18.8	14	150	50	7	170	100	D194485
D194486	1.0	70	26.1	12	100	50	2	130	70	D194486
D194459	.1L	200	4.3	4.1	50	10	1	17	10	D194459
D194460	.5	300	3.9	3.5	30	7	1	20	10	D194460
D194461	3.1	200	4.2	3.7	20	10	1	16	15	D194461
D194462	.7	150	2.0	2.2	20	7	.7	11	7	D194462
D194487	1.9	300	25.0	18	150	30	3	72	50	D194487
D194463	.1L	300	8.9	14	70	30	3	68	30	D194463
D194488	1.9	150	23.1	20	150	30	3	74	70	D194488
D194464	.1L	500	5.8	12	70	20	1.5	46	15	D194464

Table C10.

Elements looked for, but not detected in coal and coal associated shale samples from the Coalmont Formation, McCallum and Coalmont areas, North Park, Jackson County, Colo.

[Approximate lower detection limits for these elements in ash, by the six-step spectrographic method of the U.S. Geological Survey, are included]

Element name	Symbol	Lower limit of detection (ppm) in ash
Silver	Ag	1
Gold	Au	50
Bismuth	Bi	20
Cerium	Ce	500
Dysprosium	Dy	100
Erbium	Er	100
Europium	Eu	200
Gadolinium	Gd	100
Germanium	Ge	20
Hafnium	Hf	200
Holmium	Ho	50
Indium	In	20
Lutetium	Lu	70
Palladium	Pd	5
Praseodymium	Pr	200
Platinum	Pt	100
Rhenium	Re	100
Samarium	Sm	200
Tin	Sn	20
Tantalum	Ta	1,000
Terbium	Tb	700
Tellurium	Te	5,000
Thallium	Tl	100
Thulium	Tm	50
Tungsten	W	200

Table C11.

Arithmetic mean, observed range, geometric mean, and geometric deviation of proximate and ultimate analyses, heat-of-combustion, forms-of-sulfur, and ash-fusion temperatures of 21 coal samples from the Sudduth bed, Coalmont Formation, McCallum area, North Park, Jackson County, Colo.

[All values are in percent except Kcal/kg, Btu/lb, ash-fusion temperatures, and geometric deviation and are reported on the as-received basis. °F = (°C x 1.8) + 32; Kcal/kg = 0.556 (Btu/lb)]

	Arithmetic mean	Observed range		Geometric mean	Geometric deviation
		Minimum	Maximum		
Proximate and ultimate analyses					
Moisture	15.0	11.0	20.7	14.8	1.2
Volatile matter	32.9	27.4	38.3	32.8	1.1
Fixed carbon	44.3	37.1	49.1	44.2	1.1
Ash	8.0	2.1	19.2	6.8	1.8
Hydrogen	5.7	5.0	5.9	5.7	1.0
Carbon	58.6	49.3	64.3	58.4	1.1
Nitrogen	.9	.6	1.5	.9	1.2
Oxygen	26.7	23.9	31.3	26.6	1.1
Sulfur	.3	.2	.6	.3	1.4
Heat of combustion					
Kcal/kg	5,635	4,770	6,270	5,615	1.7
Btu/lb	10,135	8,580	11,280	10,100	1.1
Forms of sulfur					
Sulfate	0.03	0.01L	0.05	0.02	1.7
Pyritic	.08	.04	.16	.07	1.4
Organic	.18	.06	.59	.16	1.7
Ash-fusion temperatures, °C					
Initial deformation	1,295	1,120	1,600 +	1,285	1.1
Softening temperature	1,320	1,150	1,600 +	1,310	1.1
Fluid temperature	1,365	1,175	1,600 +	1,355	1.1

Table C12.

Arithmetic mean, observed range, geometric mean, and geometric deviation of ash content and contents of 10 major and minor oxides in the laboratory ash of 21 coal samples from the Sudduth bed, Coalmont Formation in the McCallum area, North Park, Jackson County, Colo.

[All samples were ashed at 525°C; all analyses except geometric deviation are in percent]

Oxide	Arithmetic mean	Observed range		Geometric mean	Geometric deviation
		Minimum	Maximum		
(Ash)	8.5	2.7	19.1	7.4	1.7
SiO_2	43	16	56	41	1.4
Al_2O_3	22	15	30	22	1.2
CaO	9.7	3.0	22	8.5	1.7
MgO	1.17	.46	2.46	1.06	1.6
Na_2O	.58	.09	5.1	.30	3.2
K_2O	.38	.09	1.4	.27	2.3
Fe_2O_3	5.0	1.6	12	4.5	1.6
TiO_2	1.1	.57	1.8	1.1	1.4
So_3	7.3	2.5	14	6.6	1.5
P_2O_5	.81	.05	1.9	.62	2.4

Table C13.

Arthimetic mean, observed range, geometric mean, and geometric deviation of 37 elements in 21 coal samples from the Sudduth bed, Coalmont Formation in the McCallum area, North Park, Jackson County, Colo.

[All analyses are in percent or parts per million and are reported on a whole-coal basis. As, F, Hg, Sb, Se, Th, and U values used to calculate the statistics were determined directly on whole coal. All other values used were calculated from determinations made on coal ash. L, less than the value shown]

Element	Arithmetic mean	Observed range		Geometric mean	Geometric deviation
		Minimum	Maximum		
		Percent			
Si	1.9	0.20	4.8	1.4	2.2
Al	1.1	.21	2.8	.85	1.9
Ca	.48	.24	.90	.45	1.4
Mg	.053	.023	.16	.047	1.7
Na	.045	.003	.30	.016	4.2
K	.033	.003	.14	.017	3.3
Fe	.25	.13	.37	.23	1.4
Ti	.059	.012	.14	.047	2.0
		Parts per million			
As	1.9	0.8	3.0	1.7	1.5
B	70	15	200	50	2.2
Ba	150	100	200	150	1.3
Be	.3	.1L	2	.15	4.6
Co	1	.3	3	.7	2.2
Cr	2	.5	15	1.5	2.3
Cu	8.0	3.0	36	6.8	1.8
F	50	20L	130	44	1.7
Ga	5	.5	20	3	2.8
Hg	.06	.01	.28	.04	2.3
La	5	3L	20	3	2.7
Li	7.6	.9	25	4.8	2.6
Mn	27	9.0	71	16	2.8
Mo	.7	.2L	3	.5	2.5
Nb	2	.3L	5	1	4.2
Ni	1.5	.7	3	1	1.8
P	270	22	870	200	2.5
Pb	4.3	.9	12	3.3	2.0
Sb	.2	.1L	.5	.2	1.8
Sc	1.5	.3	3	1	1.8
Se	.9	.1L	2.7	.7	2.3
Sr	100	30	300	100	1.9
Th	2.4	1.5	7.7	1.9	2.0
U	.8	.2L	2.7	.4	2.9
V	10	3	30	7	1.9
Y	3	.7	15	3	2.1
Yb	.3	.07	1	.2	2.1
Zn	8.7	1.9	23	6.5	2.1
Zr	20	5L	100	10	3.1

Table C14.

Arithmetic mean, observed range, geometric mean, and geometric deviation of proximate and ultimate analyses, heat-of-combustion, forms-of-sulfur, and ash-fusion temperatures of 12 coal samples from the Riach bed, Coalmont Formation in the Coalmont area, North Park, Jackson County, Colo.

[All values are in percent except Kcal/kg, Btu/lb, ash-fusion temperatures, and geometric deviation and are reported on the as-received basis. °F = (C° x 1.8) + 32; Kcal/kg = 0.556 (Btu/lb)]

	Arithmetic mean	Observed range		Geometric mean	Geometric deviation
		Minimum	Maximum		
Proximate and ultimate analyses					
Moisture	17.6	14.5	20.2	17.5	1.1
Volatile matter	31.3	24.5	37.3	31.1	1.1
Fixed carbon	34.6	22.8	43.9	33.9	1.2
Ash	16.9	5.1	37.0	13.8	1.9
Hydrogen	5.5	4.3	6.0	5.5	1.1
Carbon	47.6	32.2	55.3	46.9	1.2
Nitrogen	.9	.4	1.4	.8	1.5
Oxygen	28.9	23.0	31.8	28.7	1.1
Sulfur	.7	.3	1.4	.7	1.6
Heat of combustion					
Kcal/kg	4,570	3,060	5,320	4,505	1.2
Btu/lb	8,220	5,500	9,570	8,100	1.2
Forms of sulfur					
Sulfate	0.06	0.01	0.26	0.04	2.8
Pyritic	.29	.02	.58	.19	2.6
Organic	.43	.25	.64	.41	1.3
Ash-fusion temperatures, °C					
Initial deformation	1,310	1,125	1,600+	1,300	1.1
Softening temperature	1,335	1,150	1,600+	1,325	1.1
Fluid temperature	1,395	1,170	1,600+	1,390	1.1

Table C15.

Arithmetic mean, observed range, geometric mean, and geometric deviation of ash content and contents of 9 major and minor oxides in the laboratory ash of 12 coal samples from the Riach bed, Coalmont Formation in the Coalmont area, North Park, Jackson County, Colo.

[All samples were ashed at 525°C; all analyses except geometric deviation are in percent]

Oxide	Arithmetic mean	Observed range		Geometric mean	Geometric deviation
		Minimum	Maximum		
(Ash)	16.3	6.2	40.0	14.1	1.7
SiO_2	41	21	51	39	1.3
Al_2O_3	23	15	30	23	1.2
CaO	6.0	2.1	16	5.1	1.8
MgO	1.92	1.09	3.42	1.82	1.4
Na_2O	2.10	.09	5.40	.64	4.9
K_2O	1.1	.40	1.8	.99	1.6
Fe_2O_3	8.8	5.4	12	8.6	1.3
TiO_2	1.1	.72	1.5	1.1	1.2
SO_3	9.9	3.2	24	8.3	1.8

Table C16.

Arithmetic mean, observed range, geometric mean and geometric deviation of 37 elements in 12 coal samples from the Riach bed, Coalmont Formation in the Coalmont area, North Park, Jackson County, Colo.

[All analyses are in percent or parts per million and are reported on a whole-coal basis. As, F, Hg, Sb, Se, Th, and U values used to calculate the statistics were determined directly on whole coal. All other values used were calculated from determinations made on coal ash. L, less than the value shown. Leaders (---) indicate means could not be calculated owing to an insufficient number of analyses above the lower detection limit]

Element	Arithmetic mean	Observed range		Geometric mean	Geometric deviation
		Minimum	Maximum		
		Percent			
Si	3.5	0.61	11	2.6	2.2
Al	2.2	.48	6.3	1.7	2.0
Ca	.55	.26	.72	.52	1.4
Mg	.18	.079	.058	.16	1.8
Na	.27	.005	.33	.067	5.9
K	.18	.021	.60	.12	2.6
Fe	.93	.39	1.6	.84	1.5
Ti	.11	.027	.31	.091	1.9
		Parts per million			
As	2.0	0.6	4.0	1.7	1.8
B	50	20	70	50	1.6
Ba	300	150	500	300	1.6
Be	.7	.3	1.5	.7	1.7
Co	7	2	10	5	1.7
Cr	20	10	70	20	1.7
Cu	40	14	89	34	1.8
F	96	35	275	81	1.8
Ga	10	2	20	7	2.0
Hg	.10	.01	.21	.07	2.5
La	15	7	30	15	1.9
Li	12	1.2	38	8.4	2.4
Mn	84	40	210	76	1.6
Mo	7	3	10	7	1.4
Nb	3	1.5	7	3	1.9
Ni	15	5	20	10	1.6
P	---	84	680	---	---
Pb	7.4	2.5	16	6.0	1.9
Sb	.2	.1L	.3	.2	1.6
Sc	5	2	10	5	1.7
Se	2.0	.1L	5.7	1.1	3.2
Sr	200	150	500	200	1.4
Th	6.5	2.0	16	4.7	2.2
U	7.6	2.2	14	6.2	1.9
V	50	20	70	30	1.7
Y	10	5	30	10	1.7
Yb	1	.5	3	1	1.6
Zn	28	6.0	68	20	2.3
Zr	15	5	30	10	1.6

Section D
Chemical Analyses of Coal Samples from the
Raton Mesa Region and the Canon City Field

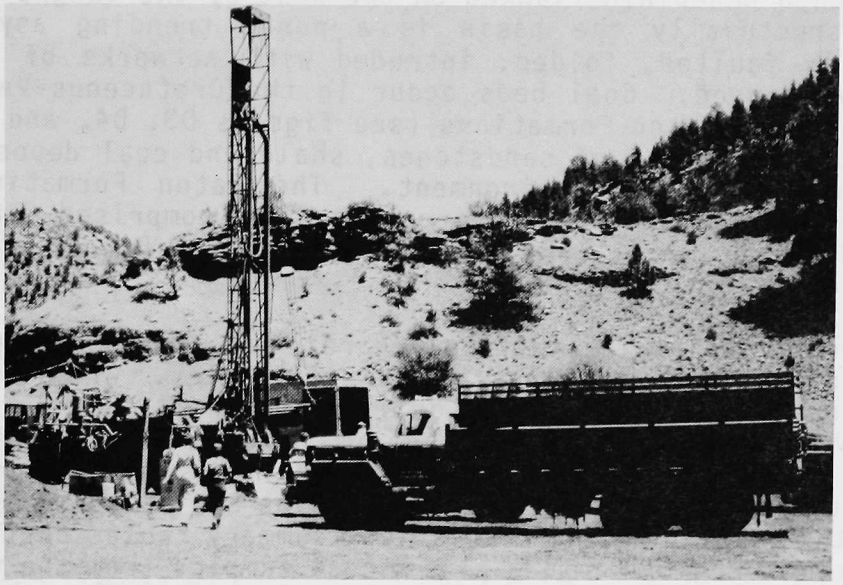


Figure D1. Exploring for coal in the Raton Mesa Region.

Raton Mesa Region and Canon City Field

Raton Mesa Region

The Colorado part of the Raton Mesa Coal Region, which is about 150 miles due south of Denver, lies entirely within Las Animas and Huerfano Counties (figure 2). The Raton Mesa Coal Region extends about 35 miles south of the Colorado border into New Mexico and represents the central or younger portion of the greater Raton Basin. Landis (1959) described the area as a trenched peneplain flanked on the west by the Sangre de Cristo Mountains. Structurally the basin is a north trending asymmetrical syncline locally faulted, folded, intruded with networks of sills and dikes, and lava capped. Coal beds occur in the Cretaceous-Vermejo and Cretaceous-Paleocene Raton Formations (see figures D3, D4, and D5). The Vermejo Formation consists of sandstones, shale and coal deposited in a regressive marginal-marine environment. The Raton Formation, which originates from a freshwater environment, is comprised of arkosic sandstone, siltstone, shale, and about 7 coal zones (Boreck and Murray, 1979).

This report contains information regarding 43 coal and 2 associated rock samples collected from 4 mines and 11 drill holes. Of these, 18 coal core samples from 4 drill holes (USGS drill holes 78-2A and 78-4A and CF&I drill holes 29-1 and 29-2) only have proximate and ultimate analyses and thus are not included in the summary tables for this section. The proximate and ultimate analyses for these samples are tabulated separately at the end of this section. The statistical summary tables pertain to the other 27 Raton Mesa Region samples plus 6 coal samples from the Canon City field. The coal rank varies from high-volatile bituminous coal (in the Canon City and Walsenburg fields) to medium volatile bituminous coal in the Trinidad field. While the ash can often vary from 5 to 20 percent, the sulfur is consistently low at around 0.6 percent.

There are two major coal fields in the Raton Mesa region in Colorado, the Walsenburg field in the north and the Trinidad field in the south. There are a total of 371 mines on record in the region which have produced over 250 million tons of coal (Boreck and Murray, 1979). In 1979, the regional production was 870,346 tons of coal from 6 producing mines (5 in the Trinidad field and 1 in the Walsenburg field) (Colorado Division of Mines, 1980).

Canon City Field

The Canon City field in Fremont County has been included with the samples from the Raton Mesa region for a number of reasons, even though they are not officially related. There are some general similarities in the stratigraphies of the coal bearing sections, with the Vermejo Formation in both areas having major coal beds deposited in analogous environments. Another reason for grouping the two areas together is their proximity. The Canon City field is only 40 miles north of the northernmost extent of coal-bearing rocks in the Raton Mesa region. The coal-bearing Vermejo rests in an asymmetrical syncline with steeply

dipping beds along the Wet Mountains to the west and more gentle dips on the eastern margin (Landis, 1959).

There are 177 coal mines of record in the Canon City field which have produced over 40 million tons of coal (Boreck and Murray, 1979). In 1979 five mines in the field produced 165,083 tons of high-volatile C bituminous coal. According to Boreck and Murray (1979) the remaining demonstrated reserve base is about 107 million tons.

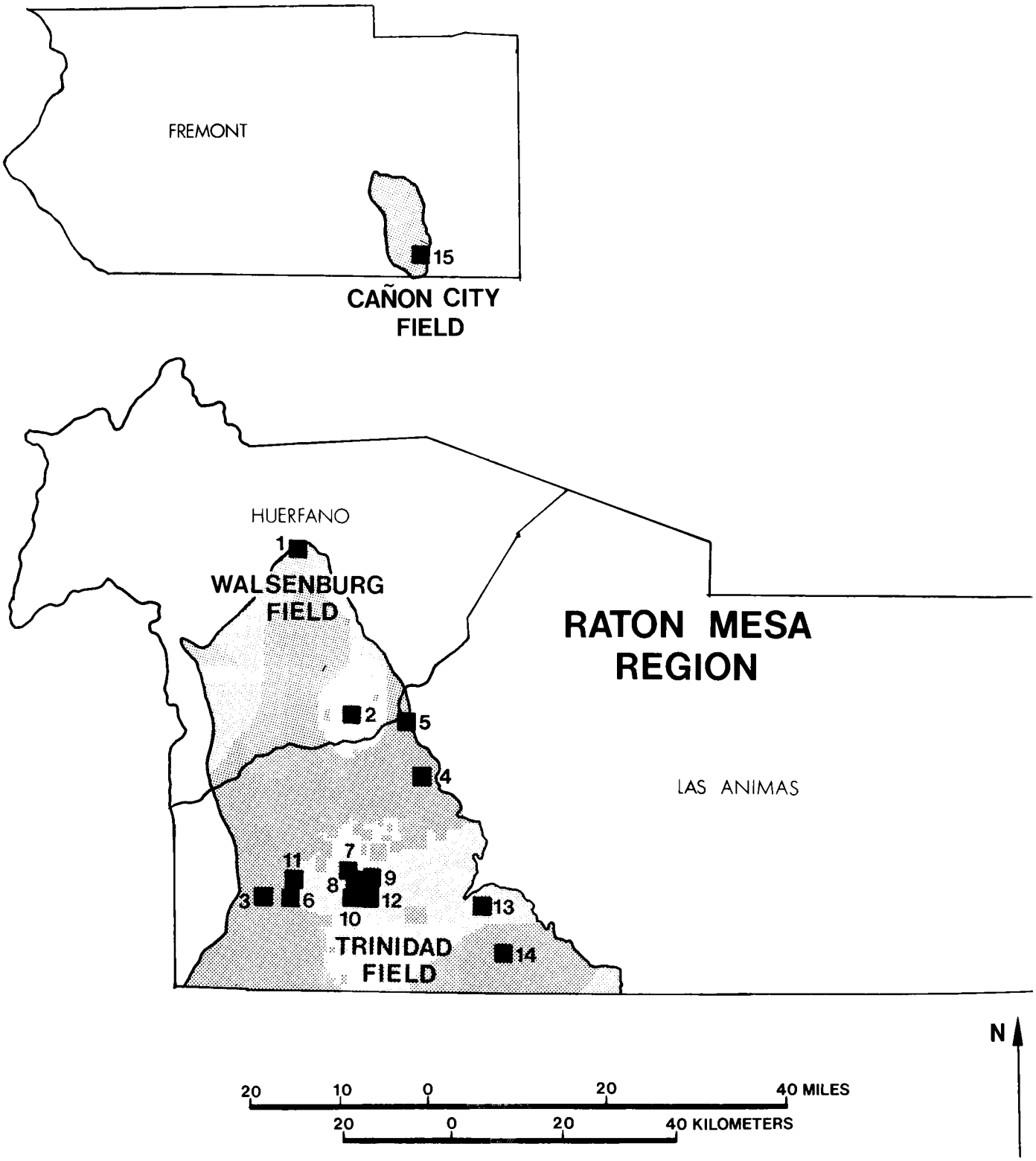


Figure D2. Location of samples within the Raton Mesa Region and Canon City field.

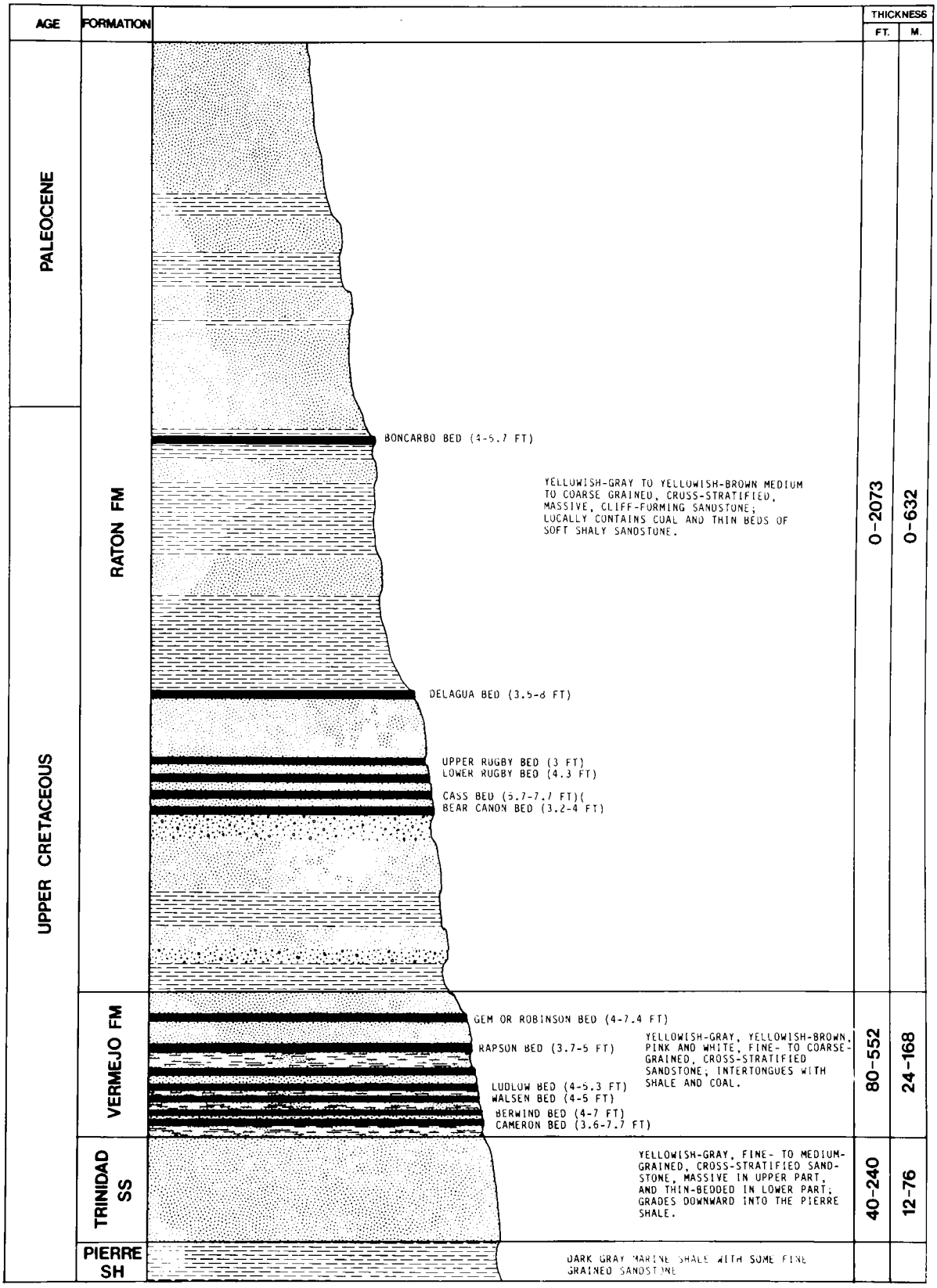


Figure D3. Generalized stratigraphic section of coal-bearing rocks in the Raton Mesa Region, Trinidad field. Coal beds shown in black (after Boreck and Murray, 1979; Harbour and Dixon, 1959; Hornbaker and others, 1976; Johnson, 1969; Wood and others, 1957).

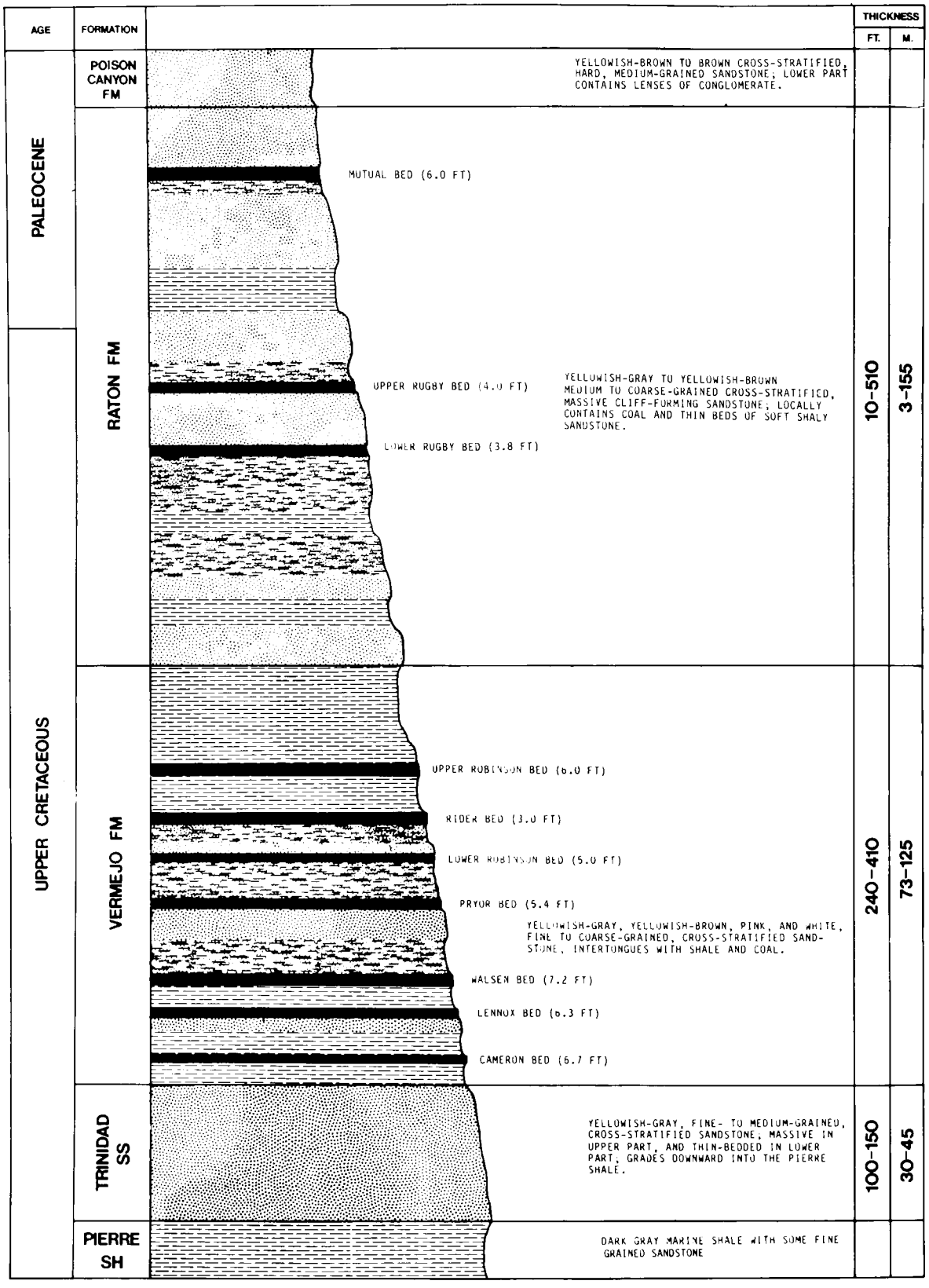


Figure D4. Generalized stratigraphic section of coal-bearing rocks in the Walsenburg field Raton Mesa Region. Coal beds shown in black (after Boreck and Murray, 1979; Hornbaker and others, 1976; Johnson, 1969; Scott and Taylor, 1974).

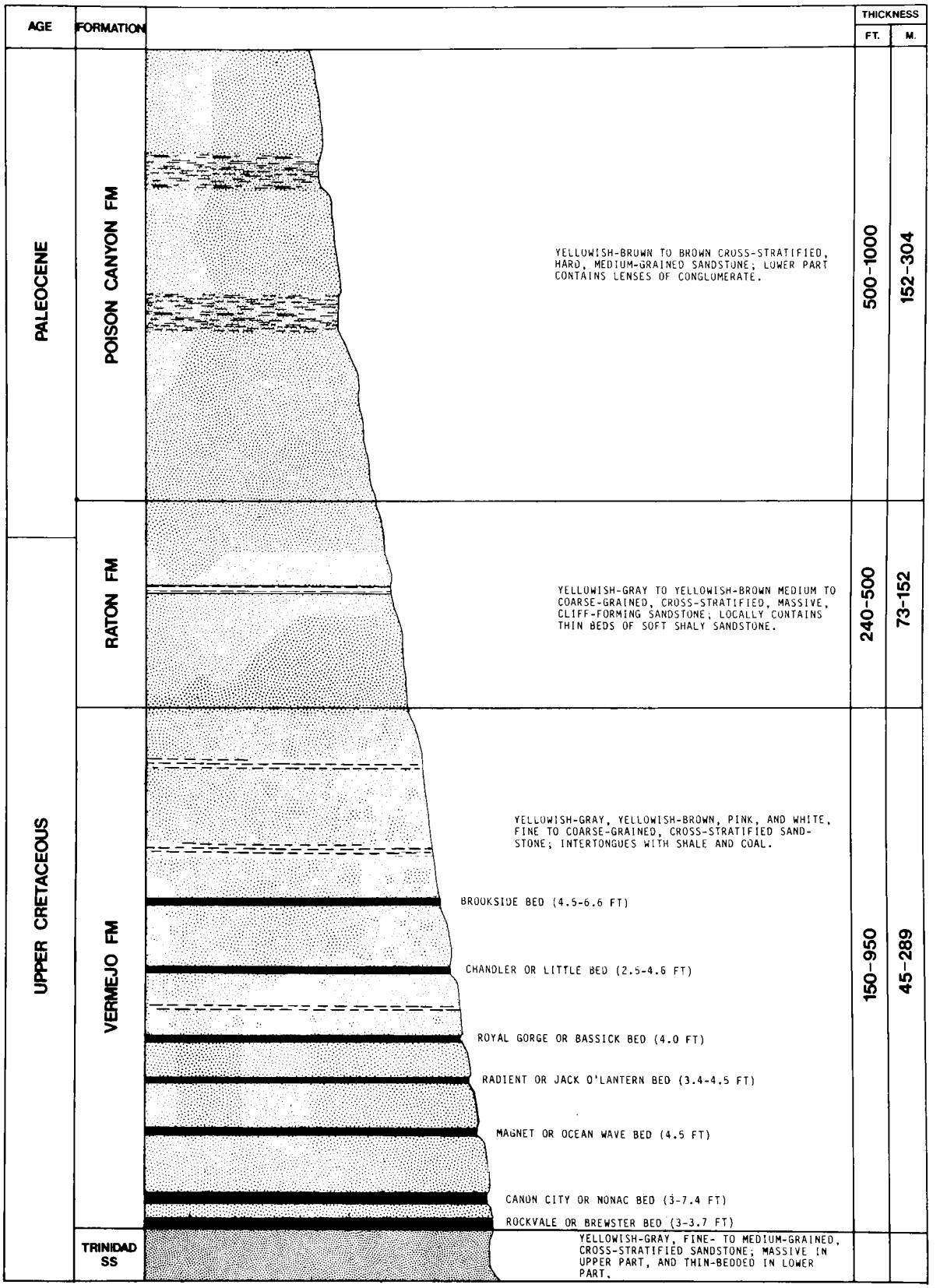


Figure D5. Generalized stratigraphic section of coal-bearing rocks in the Canon City field. Coal beds shown in black (after Boreck and others, 1977; Boreck and Murray, 1979; Hornbaker and others, 1976; Scott and Taylor, 1974).

MAP INDEX #	FIELD/AREA	COUNTY	LOCATION SEC.	TWP.	RGE.	CGS SAMPLE #	USGS SAMPLE #	US DOE SAMPLE #	SAMPLE TYPE
1	Walsenburg	Huerfano	8	27S	67W	76-DJ-5	D188241		Core
						76-DJ-6	D184634	K69857	Core
						76-DJ-8	D184635	K69858	Core
						76-DJ-9	D188242		Core
2			16	30S	66W	78-CT-3	D205232	K88633	Core
3	Trinidad	Las Animas	27	33S	68W	SG-AM-1	D201450	K85444	Channel
						SG-AM-2	D201451	K85445	Channel
4			15	31S	65W	78-SMG-6	D205219	K88426	Channel
						78-SMG-7	D205220	K88427	Channel
						78-SMG-8	D205218	K88425	Channel
5			21	30S	65W	78-JS-9	D205226	K88433	Channel
						78-JS-11	D205227	K88629	Channel
						78-SG-1	D205228	K88630	Channel
						78-SMG-2	D205221	K88428	Channel
						78-SMG-3	D205222	K88429	Channel
						78-SMG-4	D205223	K88430	Channel
						78-SMG-5	D205224	K88431	Channel
						78-SMG-10	D205225	K88432	Channel
6			29	33S	67W	SG-MM-1	D201447	K85441	Channel
						SG-MM-2	D201448	K85442	Channel
						SG-MM-3	D201449	K85443	Channel
7			9	33S	66W	MIE-4-CA	D180092	K68966	Core
8			21	33S	66W	Mobil 11C	D180090	K68964	Core
9			15	33S	66W	Mobil 9C	D180089	K68963	Core
10			29	33S	66W	Mobil 4C	D180091	K68965	Core
11			16	33S	67W	78-CT-1	D205231	K88632	Core
						78-CT-2	D205230	K88631	Core
12			27	33S	66W	Run 4		K86616	Core
						Run 6		K86617	Core
13			36	33S	64W	Run 2		K86618	Core
						Run 3		K86619	Core
									Core

Figure D6. Sample index for the Raton Mesa Region and Canon City field. (Map index number refers to figure D2.)

MAP INDEX #	FIELD/AREA	COUNTY	LOCATION SEC.	TWP.	RGE.	CGS SAMPLE #	USGS SAMPLE #	US DOE SAMPLE #	SAMPLE TYPE
14			29	34S	63W	Run 1		K85037	Core
						Run 2, Upper		K89038	Core
						Run 2, Lower		K89039	Core
						Run 3		K90194	Core
						Run 4		K90195	Core
						Run 5		K89074	Core
14			29	34S	63W	Run 1, Upper		K88878	Core
						Run 1, Lower		K89372	Core
						Run 3, Upper		K88879	Core
						Run 3, Lower		K89024	Core
						Run 4, Upper		K89025	Core
						Run 4, Lower		K89042	Core
						Run 5		K89026	Core
						Run 6		K89027	Core
15	Canon City	Fremont	19	20S	69W	78-JH-1	D201446	K85453	Coal log
						78-JS-1	D201440	K85448	Channel
						78-JS-2	D201441	K85449	Channel
						78-JS-4	D201442	K85450	Channel
						78-JS-6	D201444	K85451	Channel
15			19	20S	69W	78-JS-7	D201445	K85452	Channel

Figure D6 (cont.)

RATON MESA REGION
WALSENBURG FIELD

HUERFANO COUNTY

SAMPLE NUMBERS: 76-DJ-5,6

COAL BED NAME: Prior

GEOLOGIC ROCK UNIT: Vermejo

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: -- Meters: --

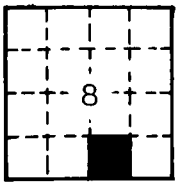
OVERBURDEN AT SAMPLING POINT:
Feet: -- Meters: --

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 8

TOWNSHIP: 27 S

RANGE: 67 W

USGS TOPOGRAPHIC QUADRANGLE:
Black Hills 7.5' (1963)

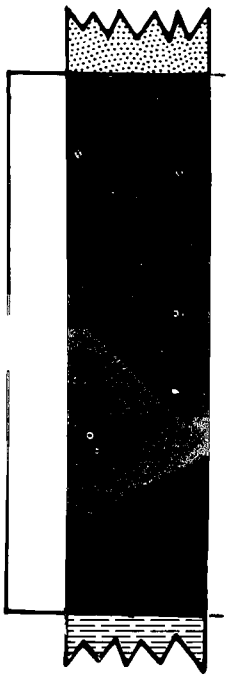
DRILL HOLE: G/C 8-6

MINE TYPE: --

OPERATOR/OWNER: Groves/Calder

Coal bed depth and thickness confidential

PRIOR COAL BED



SANDSTONE: Sample No. 76-DJ-5, gray, fine-grained, lower 0.3' interlaminated with coal stringers.

COAL: Sample No. 76-DJ-6, banded, vitrain and fusain in attritus, good cleat development.

CARBONACEOUS SHALE

SAMPLE NUMBER: 76-DJ-5

ANALYSES LABORATORY NUMBERS
USBM/DOE: - - -
USGS: D188241

APPARENT RANK OF COAL:
--

THICKNESS OF COAL:
Feet: -- Meters: --

THICKNESS SAMPLED:
Feet: -- Meters: --

TYPE OF SAMPLE: Drill Core: Roof

SAMPLE NUMBER: 76-DJ-6

ANALYSES LABORATORY NUMBERS
USBM/DOE: K69857
USGS: D184634

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: -- Meters: --

THICKNESS SAMPLED:
Feet: -- Meters: --

TYPE OF SAMPLE: Drill Core: Coal

RATON MESA REGION
WALSENBURG FIELD

HUERFANO COUNTY

SAMPLE NUMBERS: 76-DJ-8,9

COAL BED NAME: Walsen

GEOLOGIC ROCK UNIT: Vermejo

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: -- Meters: --

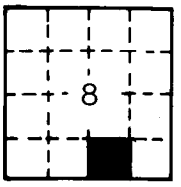
OVERBURDEN AT SAMPLING POINT:
Feet: -- Meters: --

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 8

TOWNSHIP: 27 S

RANGE: 67 W

USGS TOPOGRAPHIC QUADRANGLE:
Black Hills 7.5' (1963)

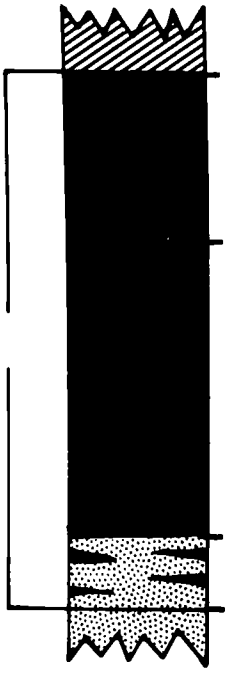
DRILL HOLE: G/C 8-6

MINE TYPE: --

OPERATOR/OWNER: Groves/Calder

Coal bed depth and thickness confidential

WALSEN COAL BED



COAL: Not sampled (not cored).

SHALY COAL: Sample No. 76-DJ-8, dull to bright attritus, 0.3' fusain band 2.0' above lower contact, blocky, abundant pyrite, some gypsum.

INTERLAMINATED COAL AND SANDSTONE: abundant pyrite, some gypsum.

SANDSTONE: Sample No. 76-DJ-9, silty, lenses of carbonaceous material, some pyrite and gypsum.

SAMPLE NUMBER: 76-DJ-8

ANALYSES LABORATORY NUMBERS
USBM/DOE: K69858
USGS: D184635

APPARENT RANK OF COAL:
High-volatile C bituminous

THICKNESS OF COAL:
Feet: -- Meters: --

THICKNESS SAMPLED:
Feet: -- Meters: --

TYPE OF SAMPLE: Drill Core: Coal

SAMPLE NUMBER: 76-DJ-9

ANALYSES LABORATORY NUMBERS
USBM/DOE: - - -
USGS: D188242

APPARENT RANK OF COAL:

THICKNESS OF COAL:
Feet: - - Meters: - -

THICKNESS SAMPLED:
Feet: - - Meters: - -

TYPE OF SAMPLE: Drill Core: Floor

RATON MESA REGION
WALSENBURG FIELD

HUERFANO COUNTY

SAMPLE NUMBER: 78-CT-3

COAL BED NAME: Delagua

GEOLOGIC ROCK UNIT: Raton

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: 10 Meters: 3

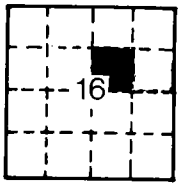
OVERBURDEN AT SAMPLING POINT:
Feet: 671 Meters: 205

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 16

TOWNSHIP: 30 S

RANGE: 66 W

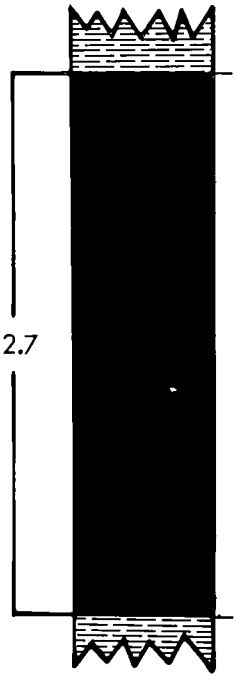
USGS TOPOGRAPHIC QUADRANGLE:
Santa Clara 7.5' (1972)

DRILL HOLE: CT-78-16-1C

MINE TYPE: --

OPERATOR/OWNER: Mobil Oil

DELAGUA COAL BED



INTERLAMINATED SANDSTONE, SHALE: gray, dark gray, carbonaceous shale with coal lenses above coal bed.

COAL: Sample No. 78-CT-3, abundant thin vitrain bands in attritus, 0.5" cleat separation.

SHALE, SANDSTONE, COAL: as above.

ANALYSES LABORATORY NUMBERS
USBM/DOE: K88633
USGS: D205232

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 2.7 Meters: 0.8

THICKNESS SAMPLED:
Feet: 2.7 Meters: 0.8

TYPE OF SAMPLE: Drill Core: Coal

RATON MESA REGION
TRINIDAD FIELD

LAS ANIMAS COUNTY

SAMPLE NUMBERS: SG-AM-1,2

COAL BED NAME: Allen

GEOLOGIC ROCK UNIT: Raton Fm

GEOLOGIC AGE: Upper Cretaceous - Paleocene

TOTAL SECTION MEASURED:
Feet: 6 Meters: 1.8

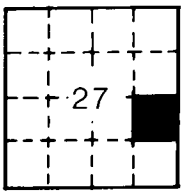
OVERBURDEN AT SAMPLING POINT:
Feet: 500 Meters: 152

STRIKE: N 60°E

DIP: 1°E

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 27

TOWNSHIP: 33 S

RANGE: 68 W

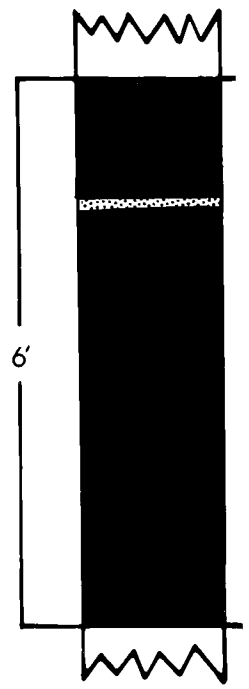
USGS TOPOGRAPHIC QUADRANGLE:
Vigil 7.5' (1971)

MINE NAME: Allen

MINE TYPE: Captive Underground

OPERATOR/OWNER: CF&I Steel

ALLEN COAL BED



CARBONACEOUS SHALE: coal stringers.

COAL: Sample No. SG-AM-1,2, 1" sandstone parting. 2.0' from upper contact.

SHALE: gray, medium hard.

SAMPLE NUMBER: SG-AM-1

ANALYSES LABORATORY NUMBERS
USBM/DOE: K85444
USGS: D201450

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 6 Meters: 1.8

THICKNESS SAMPLED:
Feet: 6 Meters: 1.8

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: SG-AM-2

ANALYSES LABORATORY NUMBERS
USBM/DOE: K85445
USGS: D201451

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 6 Meters: 1.8

THICKNESS SAMPLED:
Feet: 6 Meters: 1.8

TYPE OF SAMPLE: Coal-channel

RATON MESA REGION
TRINIDAD FIELD

LAS ANIMAS COUNTY

SAMPLE NUMBERS: 78-SMG-6,7,8

COAL BED NAME: Delagua

GEOLOGIC ROCK UNIT: Raton

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 7.8 Meters: 2.4

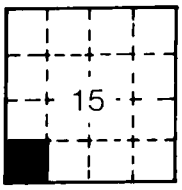
OVERBURDEN AT SAMPLING POINT:
Feet: 55 Meters: 17

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
Face: N 86°E
Butt: N 9°W

LOCATION IN SECTION



SECTION: 15

TOWNSHIP: 31 S

RANGE: 65 W

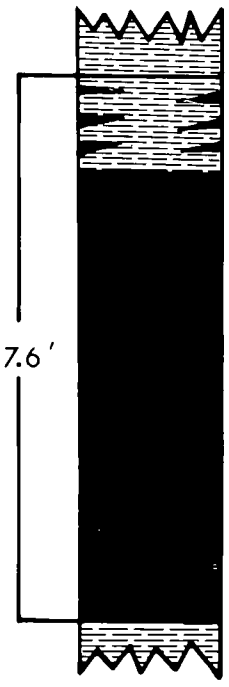
USGS TOPOGRAPHIC QUADRANGLE:
Delagua 7.5' (1971)

MINE NAME: Delagua Strip

MINE TYPE: Surface

OPERATOR/OWNER: Victor-American Fuel Co.

DELAGUA COAL BED



SHALE: gray, coarsely friable to blocky.

1.4' CARBONACEOUS SHALE: Sample No. 78-SMG-8, dark gray, abundant thin vitrain bands, sharp upper contact, irregular sharp lower contact.

3.4' COAL: Sample No. 78-SMG-6, silver gray to black, abundant vitrain in attritus, hard, rare pyrite and calcite on cleat planes.

2.8' COAL: Sample No. 78-SMG-7, as above, sharp lower contact.

SHALE: gray.

SAMPLE NUMBER: 78-SMG-6

ANALYSES LABORATORY NUMBERS
USBM/DOE: K88426
USGS: D205219

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 6.2 Meters: 1.9

THICKNESS SAMPLED:
Feet: 3.4 Meters: 1.0

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: 78-SMG-7

ANALYSES LABORATORY NUMBERS
USBM/DOE: K88427
USGS: D205220

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 6.2 Meters: 1.9

THICKNESS SAMPLED:
Feet: 2.8 Meters: 0.8

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: 78-SMG-8

ANALYSES LABORATORY NUMBERS
USBM/DOE: K88425
USGS: D205218

APPARENT RANK OF COAL:
- -

THICKNESS OF COAL:
Feet: -- Meters: --

THICKNESS SAMPLED:
Feet: 1.4 Meters: 0.4

TYPE OF SAMPLE: Rock

RATON MESA REGION
TRINIDAD FIELD

LAS ANIMAS COUNTY

SAMPLE NUMBERS: 78-JS-9,11,78-SG-1

COAL BED NAME: Robinson #2

GEOLOGIC ROCK UNIT: Vermejo

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: 5.75 Meters: 1.7

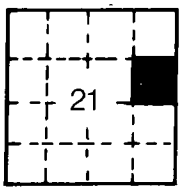
OVERBURDEN AT SAMPLING POINT:
Feet: 40 Meters: 12

STRIKE: N 31°E

DIP: 13°W

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 21

TOWNSHIP: 30 S

RANGE: 65 W

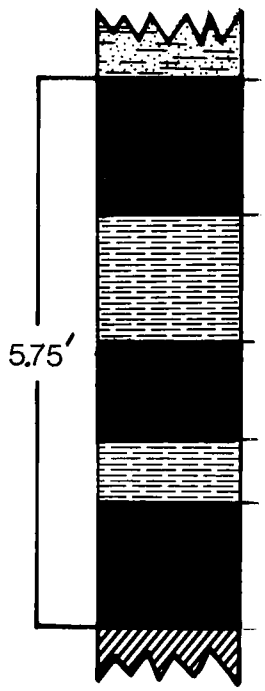
USGS TOPOGRAPHIC QUADRANGLE:
Aguilar 7.5' (1971)

MINE NAME: Jewell Strip

MINE TYPE: Surface

OPERATOR/OWNER: Horner Coal Co.

ROBINSON #2 COAL BED



CLAYSTONE: gray, few vitrain bands.

1.2' COAL: Sample No. 78-JS-9, abundant attritus with vitrain bands, also few thin, hard, dark clay bands, upper 2" of seam is a thick vitrain band, some cleats filled with pyrite.

1.3' SHALE: gray, increasingly carbonaceous toward base, fissle, 2" coal stringer near top.

1.1' COAL: Sample No. 78-JS-11, abundant attritus with vitrain bands.

0.85' SHALE

1.3' COAL: Sample No. 78-SG-1, predominantly attritus with vitrain bands.

SAMPLE NUMBER: 78-JS-9

ANALYSES LABORATORY NUMBERS
USBM/DOE: K88433
USGS: D205226

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 1.2 Meters: 0.4

THICKNESS SAMPLED:
Feet: 1.2 Meters: 0.4

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: 78-JS-11

ANALYSES LABORATORY NUMBERS
USBM/DOE: K88629
USGS: D205227

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 1.2 Meters: 0.4

THICKNESS SAMPLED:
Feet: 1.2 Meters: 0.4

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: 78-SG-1

ANALYSES LABORATORY NUMBER:
USBM/DOE: K88630
USGS: D205228

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 1.3 Meters: 0.4

THICKNESS SAMPLED:
Feet: 1.3 Meters: 0.4

TYPE OF SAMPLE: Coal-channel

RATON MESA REGION
TRINIDAD FIELD

LAS ANIMAS COUNTY

SAMPLE NUMBERS: 78-SMG-2,3,4,5,10

COAL BED NAME: Robinson #2

GEOLOGIC ROCK UNIT: Vermejo Fm

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: 6.8 Meters: 2.1

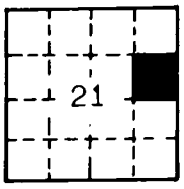
OVERBURDEN AT SAMPLING POINT:
Feet: 40 Meters: 12

STRIKE: N 31°E

DIP: 13°W

MAJOR CLEAT ORIENTATION IN COAL:
Face: N 85°E
Butt: N 32°W

LOCATION IN SECTION



SECTION: 21

TOWNSHIP: 30 S

RANGE: 65 W

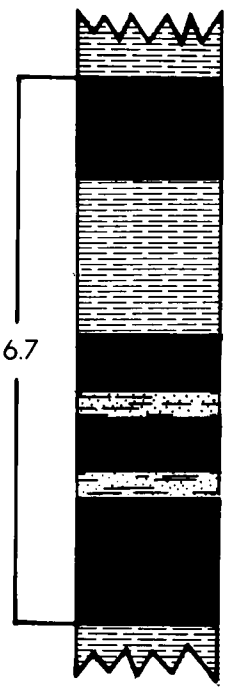
USGS TOPOGRAPHIC QUADRANGLE:
Aguilar 7.5' (1971)

MINE NAME: Jewell Strip

MINE TYPE: Surface

OPERATOR/OWNER: Horner Coal Co.

ROBINSON #2 COAL BED



SHALE: dark gray, friable, carbonized plant material on bedding planes, some vitrain lenses.

1.25' COAL: Sample No. 78-SMG-2,10, dominant attritus with vitrain bands, irridescent colored mineralization (iron oxide?) on cleat planes.

1.9' SHALE: gray, friable, root zone at top, rare vitrain stringers, carbonized plant material on bedding planes, upper and lower 1", very carbonaceous, gradational lower contact.

0.7 COAL: Sample No. 78-SMG-3, dominant attritus, 0.1" clay parting 2" from top.

0.23' CLAY

0.68' COAL: Sample No. 78-SMG-4, as above.

0.13' CLAY

1.8' COAL: Sample No. 78-SMG-5, as above.

SILTY SHALE: light gray, carbonized plant material, root zone at top.

SAMPLE NUMBER: 78-SMG-2

ANALYSES LABORATORY NUMBERS
USBM/DOE: K88428
USGS: D205221

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 1.3 Meters: 0.4

THICKNESS SAMPLED:
Feet: 1.3 Meters: 0.4

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: 78-SMG-3

ANALYSES LABORATORY NUMBERS
USBM/DOE: K88429
USGS: D205222

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 0.7 Meters: 0.2

THICKNESS SAMPLED:
Feet: 0.7 Meters: 0.2

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: 78-SMG-4

ANALYSES LABORATORY NUMBERS
USBM/DOE: K88430
USGS: D205223

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 0.7 Meters: 0.2

THICKNESS SAMPLED:
Feet: 0.7 Meters: 0.2

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: 78-SMG-5

ANALYSES LABORATORY NUMBERS
USBM/DOE: K88431
USGS: D205224

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 1.8 Meters: 0.5

THICKNESS SAMPLED:
Feet: 1.8 Meters: 0.5

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: 78-SMG-10

ANALYSES LABORATORY NUMBERS
USBM/DOE: K88432
USGS: D205225

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 1.3 Meters: 0.4

THICKNESS SAMPLED:
Feet: 1.3 Meters: 0.4

TYPE OF SAMPLE: Coal-channel

RATON MESA REGION
TRINIDAD FIELD

LAS ANIMAS COUNTY

SAMPLE NUMBERS: SG-MM-1,2,3

COAL BED NAME: Apache

GEOLOGIC ROCK UNIT: Raton

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: 8.5 Meters: 2.6

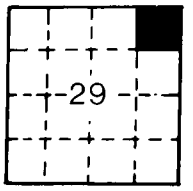
OVERBURDEN AT SAMPLING POINT:
Feet: 500 Meters: 152

STRIKE: N 60°E

DIP: 1°E

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 29

TOWNSHIP: 33 S

RANGE: 67 W

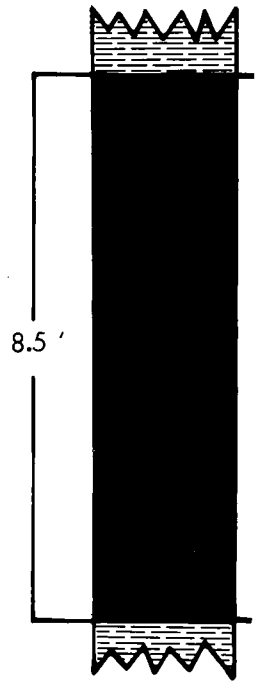
USGS TOPOGRAPHIC QUADRANGLE:
Vigil 7.5' (1971)

MINE NAME: Maxwell

MINE TYPE: Underground

OPERATOR/OWNER: CF&I Steel Corp.

APACHE COAL BED



CARBONACEOUS SHALE: thin coal lenses.

COAL: Sample No. SG-MM-1,2,3.

SHALE: gray, medium hard.

SAMPLE NUMBER: SG-MM-1

ANALYSES LABORATORY NUMBERS
USBM/DOE: K85441
USGS: D201447

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 8.5 Meters: 2.6

THICKNESS SAMPLED:
Feet: 8.5 Meters: 2.6

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBERS: SG-MM-2

ANALYSES LABORATORY NUMBERS
USBM/DOE: K85442
USGS: D201448

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 8.5 Meters: 2.6

THICKNESS SAMPLED:
Feet: 8.5 Meters: 2.6

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: SG-MM-3

ANALYSES LABORATORY NUMBERS
USBM/DOE: K85443
USGS: D201449

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 8.5 Meters: 2.6

THICKNESS SAMPLED:
Feet: 8.5 Meters: 2.6

TYPE OF SAMPLE: Coal-channel

RATON MESA REGION
TRINIDAD FIELD

LAS ANIMAS COUNTY

SAMPLE NUMBER: MIE-4-CA

COAL BED NAME: Unnamed

GEOLOGIC ROCK UNIT: Raton

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 6 Meters: 1.8

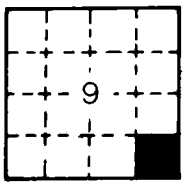
OVERBURDEN AT SAMPLING POINT:
Feet: 542 Meters: 165

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 9

TOWNSHIP: 33 S

RANGE: 66 W

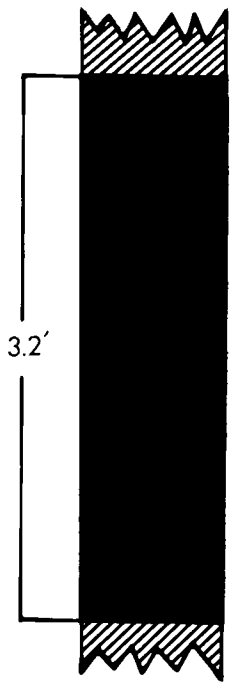
USGS TOPOGRAPHIC QUADRANGLE:
Weston 7.5' (1971)

DRILL HOLE: Mobil MIE-4-CA

MINE TYPE: --

OPERATOR/OWNER: Mobil Oil

COAL BED NAME UNKNOWN



COAL: Sample No. Mie-4-CA

ANALYSES LABORATORY NUMBERS
USBM/DOE: K68966
USGS: D180092

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 3.2 Meters: 1.0

THICKNESS SAMPLED:
Feet: 3.2 Meters: 1.0

TYPE OF SAMPLE: Drill Core: Coal

RATON MESA REGION
TRINIDAD FIELD

LAS ANIMAS COUNTY

SAMPLE NUMBER: Mobil 11C

COAL BED NAME: Unnamed

GEOLOGIC ROCK UNIT: Raton

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 9.4 Meters: 2.9

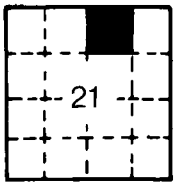
OVERBURDEN AT SAMPLING POINT:
Feet: 225 Meters: 69

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 21

TOWNSHIP: 33 S

RANGE: 66 W

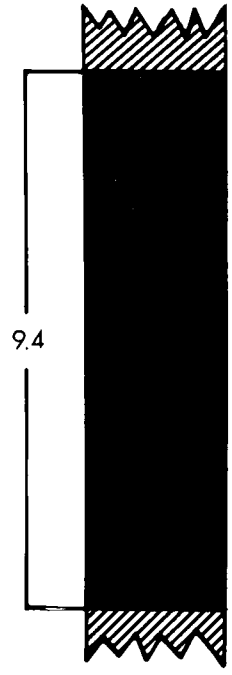
USGS TOPOGRAPHIC QUADRANGLE:
Weston 7.5' (1971)

DRILL HOLE: Mobil 11C

MINE TYPE: --

OPERATOR/OWNER: Mobil Oil

COAL BED NAME UNKNOWN



COAL: SAMPLE NO. 11C

ANALYSES LABORATORY NUMBERS:
USBM/DOE: K68964
USGS: D130090

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 9.4 Meters: 2.9

THICKNESS SAMPLED:
Feet: 9.4 Meters: 2.9

TYPE OF SAMPLE: Drill Core: Coal

RATON MESA REGION
TRINIDAD FIELD

LAS ANIMAS COUNTY

SAMPLE NUMBER: Mobil 9C

COAL BED NAME: Unnamed

GEOLOGIC ROCK UNIT: Raton

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 8 Meters: 2.4

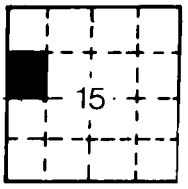
OVERBURDEN AT SAMPLING POINT:
Feet: 322 Meters: 98

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 15

TOWNSHIP: 33 S

RANGE: 66 W

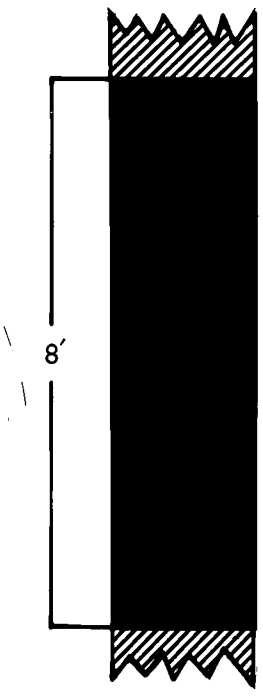
USGS TOPOGRAPHIC QUADRANGLE:
Weston 7.5' (1971)

DRILL HOLE: Mobil D.H. 9C

MINE TYPE:

OPERATOR/OWNER: Mobil Oil

COAL BED NAME UNKNOWN



COAL: Sample No. 9C

ANALYSES LABORATORY NUMBERS
USBM/DOE: K68963
USGS: D180089

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 8 Meters: 2.4

THICKNESS SAMPLED:
Feet: 8 Meters: 2.4

TYPE OF SAMPLE: Drill Core: Coal

RATON MESA REGION
TRINIDAD FIELD

LAS ANIMAS COUNTY

SAMPLE NUMBER: Mobil 14C

COAL BED NAME: Unnamed

GEOLOGIC ROCK UNIT: Raton

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 1.7 Meters: 0.5

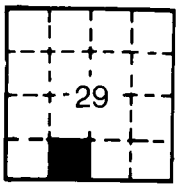
OVERBURDEN AT SAMPLING POINT:
Feet: 139 Meters: 43

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 29

TOWNSHIP: 33 S

RANGE: 66 W

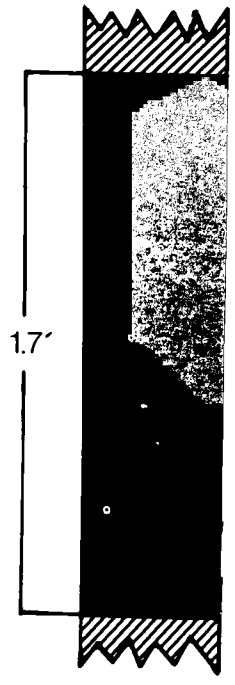
USGS TOPOGRAPHIC QUADRANGLE:
Weston 7.5' (1971)

DRILL HOLE: Mobil 14C

MINE TYPE: --

OPERATOR/OWNER: Mobil Oil

COAL BED NAME UNKNOWN



COAL: Sample No. 14C

ANALYSES LABORATORY NUMBERS
USBM/DOE: K68965
USGS: D180091

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 1.7 Meters: 0.5

THICKNESS SAMPLED:
Feet: 1.7 Meters: 0.5

TYPE OF SAMPLE: Drill Core: Coal

LAS ANIMAS COUNTY

SAMPLE NUMBER: 78-CT-1,2,

COAL BED NAME: Unnamed

GEOLOGIC ROCK UNIT: Raton

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: 8.1 Meters: 2.5

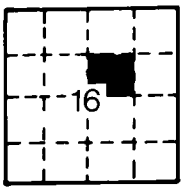
OVERBURDEN AT SAMPLING POINT:
Feet: 263 Meters: 80

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 16

TOWNSHIP: 33 S

RANGE: 67 W

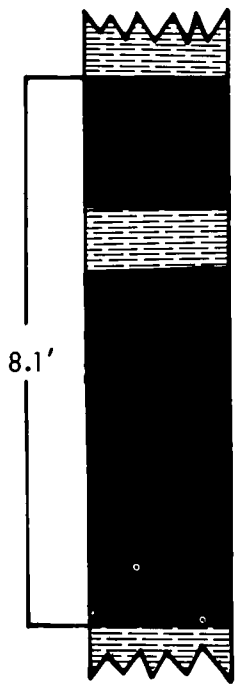
USGS TOPGRAPHIC QUADRANGLE:
Vigil 7.5' (1971)

DRILL HOLE: CT-78-16-2C

MINE TYPE: --

OPERATOR/OWNER: Mobil Oil

COAL BED NAME UNKNOWN



1.4' COAL: Sample No. 78-CT-2.

0.9' CARBONACEOUS SHALE: parting.

5.8' COAL: Sample No. 78-CT-1.

SANDSTONE: gray, carbonaceous shale at top.

SAMPLE NUMBER: 78-CT-1

ANALYSES LABORATORY NUMBERS
USBM/DOE: K88632
USGS: D205231

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 5.8 Meters: 1.8

THICKNESS SAMPLED:
Feet: 5.8 Meters: 1.8

TYPE OF SAMPLE: Drill Core: Coal

SAMPLE NUMBER: 78-CT-2

ANALYSES LABORATORY NUMBERS
USBM/DOE: K88631
USGS: D205230

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 1.4 Meters: 0.4

THICKNESS SAMPLED:
Feet: 1.4 Meters: 0.4

TYPE OF SAMPLE: Drill Core: Coal

RATON MESA REGION
TRINIDAD FIELD

LAS ANIMAS COUNTY

SAMPLE NUMBER: 78-2A Run 4

COAL BED NAME: Frederick - Martinez

GEOLOGIC ROCK UNIT: Raton

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 7 Meters: 2.1

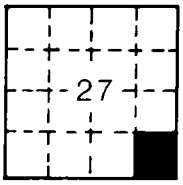
OVERBURDEN AT SAMPLING POINT:
Feet: 483 Meters: 147

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 27

TOWNSHIP: 33 S

RANGE: 66 W

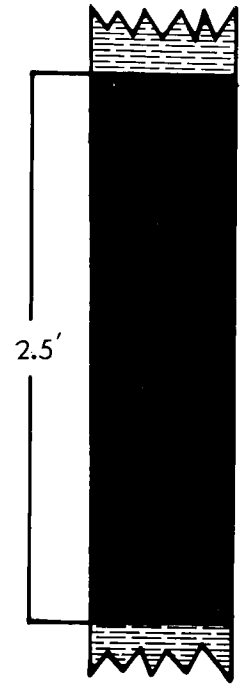
USGS TOPOGRAPHIC QUADRANGLE:
Weston 7.5' (1971)

DRILL HOLE: USGS 78-2A

MINE TYPE: --

OPERATOR/OWNER: USGS Coal Resources

COAL BED NAME UNKNOWN



CARBONACEOUS SHALE: medium to dark gray.

COAL: Sample No. 78-2A Run 4, blocky, very friable, gassy, predominantly vitrain.

CARBONACEOUS SHALE: as above.

ANALYSES LABORATORY NUMBERS
USBM/DOE: K86616
USGS: - - -

APPARENT RANK OF COAL:
Medium-volatile bituminous

THICKNESS OF COAL:
Feet: 2.5 Meters: 0.8

THICKNESS SAMPLED:
Feet: 1.0 Meters: 0.3

TYPE OF SAMPLE: Drill Core: Coal

RATON MESA REGION
TRINIDAD FIELD

LAS ANIMAS COUNTY

SAMPLE NUMBER: 78-2A Run 6

COAL BED NAME: Unnamed

GEOLOGIC ROCK UNIT: Raton

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 1.8 Meters: 0.5

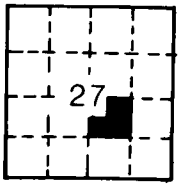
OVERBURDEN AT SAMPLING POINT:
Feet: 536 Meters: 163

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 27

TOWNSHIP: 33 S

RANGE: 66 W

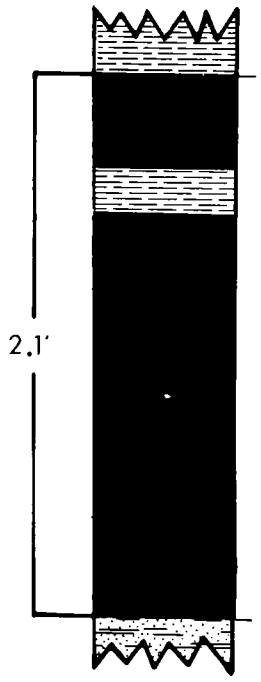
USGS TOPOGRAPHIC QUADRANGLE:
Weston 7.5' (1971)

DRILL HOLE: USGS 78-2A

MINE TYPE: --

OPERATOR/OWNER: USGS Coal Resources

COAL BED NAME UNKNOWN



SHALE

COAL: Sample No. 78-2A Run 6, banded, abundant vitrain in bright attritus, blocky, good cleat development, 0.35' carbonaceous shale parting 0.57' below upper contact (parting not sampled).

SILTSTONE

ANALYSES LABORATORY NUMBERS
USBM/DOE: K86617
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 1.8 Meters: 0.5

THICKNESS SAMPLED:
Feet: 1.8 Meters: 0.5

TYPE OF SAMPLE: Drill Core: Coal

RATON MESA REGION
TRINIDAD FIELD

LAS ANIMAS COUNTY

SAMPLE NUMBER: 78-4A Run 2

COAL BED NAME: Unnamed

GEOLOGIC ROCK UNIT: Vermejo

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 7 Meters: 2.1

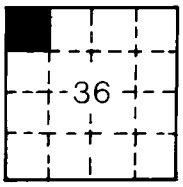
OVERBURDEN AT SAMPLING POINT:
Feet: 100 Meters: 31

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 36

TOWNSHIP: 33 S

RANGE: 64 W

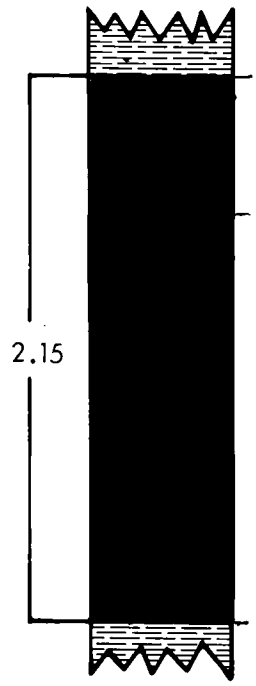
USGS TOPOGRAPHIC QUADRANGLE:
Trinidad West 7.5' (1951)

DRILL HOLE: USGS 78-4A

MINE TYPE: --

OPERATOR/OWNER: USGS Coal Resources

COAL BED NAME UNKNOWN



CARBONACEOUS SHALE: dark brown to black, hard, slickensides.

0.55' COAL: Sample No. 78-4A Run 2, banded, vitrain in bright to dull attritus, blocky, good cleat development.

1.6' COAL: Not sampled, as above, some shaly coal, sharp basal contact.

CARBONACEOUS SHALE: as above.

ANALYSES LABORATORY NUMBERS
USBM/DOE: K86618
USGS: ---

APPARENT RANK OF COAL:
Medium-volatile bituminous

THICKNESS OF COAL:
Feet: 2.2 Meters: 0.7

THICKNESS SAMPLED:
Feet: 0.6 Meters: 0.2

TYPE OF SAMPLE: Drill Core: Coal

RATON MESA REGION
TRINIDAD FIELD

LAS ANIMAS COUNTY

SAMPLE NUMBER: 78-4A Run 3

COAL BED NAME: Unnamed

GEOLOGIC ROCK UNIT: Vermejo

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 10.0 Meters: 3.0

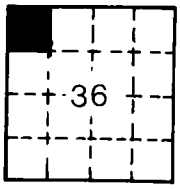
OVERBURDEN AT SAMPLING POINT:
Feet: 167.9 Meters: 51.2

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 36

TOWNSHIP: 33 S

RANGE: 64 W

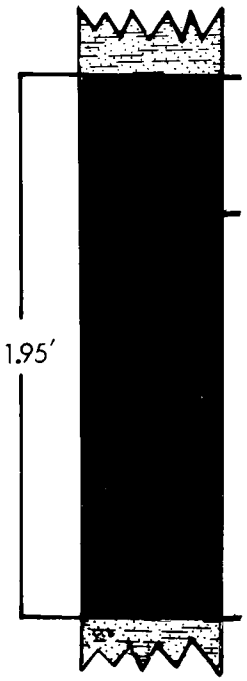
USGS TOPOGRAPHIC QUADRANGLE:
Trinidad West 7.5' (1951)

DRILL HOLE: USGS: 78-4A

MINE TYPE: --

OPERATOR/OWNER: USGS Coal Resources

COAL BED NAME UNKNOWN



CARBONACEOUS SILTSTONE: dark gray, coal lenses near base.

0.55' COAL: Sample No. 78-4A Run 3, banded, vitrain in dull attritus, hard, poorly defined cleat directions.

1.4' COAL: Not sampled.

CARBONACEOUS SILTSTONE: dark gray, grading into fine-grained sandstone.

ANALYSES LABORATORY NUMBERS
USBM/DOE: K86619
USGS: --

APPARENT RANK OF COAL:
Medium-volatile bituminous

THICKNESS OF COAL:
Feet: 1.95 Meters: 0.6

THICKNESS SAMPLED:
Feet: 0.55 Meters: 0.2

TYPE OF SAMPLE: Drill Core: Coal

RATON MESA REGION
TRINIDAD FIELD

LAS ANIMAS COUNTY

SAMPLE NUMBER: CFI 29-1 Run 1

COAL BED NAME: Cokedale (?)

GEOLOGIC ROCK UNIT: Vermejo Fm

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 15 Meters: 4.6

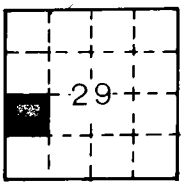
OVERBURDEN AT SAMPLING POINT:
Feet: 715.6 Meters: 218

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 29

TOWNSHIP: 34 S

RANGE: 63 W

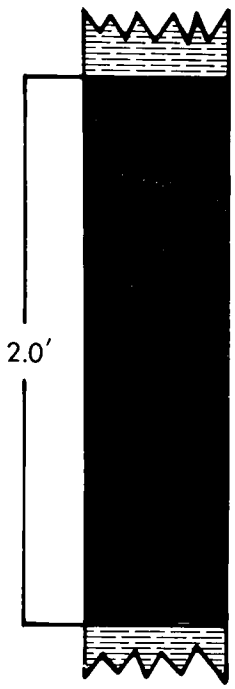
USGS TOPOGRAPHIC QUADRANGLE:
Fisher's Peak 7.5' (1971)

DRILL HOLE: CF&I 29-1

MINE TYPE: --

OPERATOR/OWNER: CF&I

COKEDALE COAL BED



CARBONACEOUS SHALE

COAL: Sample No. CFI 29-1 Run 1, hard, abundant thin to medium thick vitrain bands in bright attritus.

CARBONACEOUS SILTSTONE: few vitrain bands, trace pyrite.

ANALYSES LABORATORY NUMBERS
USBM/DOE: K85037
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 2 Meters: 0.6

THICKNESS SAMPLED:
Feet: 2 Meters: 0.6

TYPE OF SAMPLE: Drill Core: Coal

RATON MESA REGION
TRINIDAD FIELD

LAS ANIMAS COUNTY

SAMPLE NUMBERS: CFI-29-1 Run 2 upper, lower

COAL BED NAME: Piedmont

GEOLOGIC ROCK UNIT: Vermejo Fm

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 50 Meters: 15

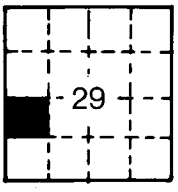
OVERBURDEN AT SAMPLING POINT:
Feet: 810 Meters: 247

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 29

TOWNSHIP: 34 S

RANGE: 63 W

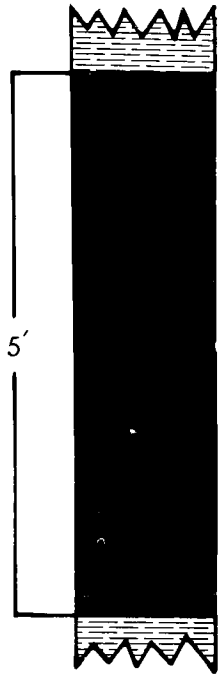
USGS TOPOGRAPHIC QUADRANGLE:
Fisher's Peak 7.5' (1971)

DRILL HOLE: CF&I 29-1

MINE TYPE: --

OPERATOR/OWNER: CF&I

PIEDMONT COAL BED



SILTSTONE

2.5' COAL: Sample No. CFI 29-1 Run 2 Upper, hard, vitrain bands in moderately bright a attritus, pyrite along cleat, some calcite.

2.5' COAL: Sample No. CFI 29-1 Run 2 Lower, as above.

SHALE: dark gray to black.

SAMPLE NUMBER: CFI-1 Run 2 upper

ANALYSES LABORATORY NUMBERS
USBM/DOE: K89038
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 5.0 Meters: 1.5

THICKNESS SAMPLED:
Feet: 2.5 Meters: 0.8

TYPE OF SAMPLE: Drill Core: Coal

RATON MESA REGION
TRINIDAD FIELD

SAMPLE NUMBER: CFI 29-1 Run 2 lower

ANALYSES LABORATORY NUMBERS
USBM/DOE: K89039
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 5.0 Meters: 1.5

THICKNESS SAMPLED:
Feet: 2.5 Meters: 0.8

TYPE OF SAMPLE: Drill Core: Coal

RATON MESA REGION
TRINIDAD FIELD

LAS ANIMAS COUNTY

SAMPLE NUMBERS: CFI 29-1 Run 3,4,5

COAL BED NAME: Morley

GEOLOGIC ROCK UNIT: Vermejo Fm

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 26 Meters: 7.9

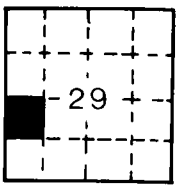
OVERBURDEN AT SAMPLING POINT:
Feet: 857.5 Meters: 261.4

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 29

TOWNSHIP: 34 S

RANGE: 63 W

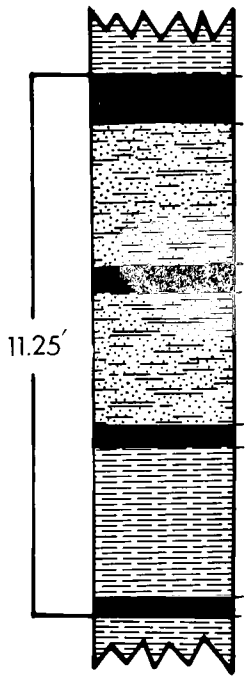
USGS TOPOGRAPHIC QUADRANGLE:
Fisher's Peak 7.5' (1971)

DRILL HOLE: CFI 29-1

MINE TYPE: --

OPERATOR/OWNER: CF&I

MORELY COAL BED



CARBONACEOUS SHALE

1.2' COAL: Sample No. CFI 29-1 Run 3, bright, dominant vitrain in attritus, calcite in fractures, some pyrite.

2.65' INTERBEDDED SANDSTONE AND SHALE

0.8' COAL: Sample No. CFI 29-1 Run 4, moderately bright attritus.

2.5' INTERBEDDED SANDSTONE AND SHALE: coarsening upward.

0.5' COAL: Sample No. CFI 29-1 Run 5, hard, brittle.

3.2' SHALE: gray.

0.4' COAL: Sample No. CFI 29-1 Run 5, as above.

SAMPLE NUMBER: CFI 29-1 Run 3

ANALYSES LABORATORY NUMBERS
USBM/DOE: K90194
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 1.2 Meters: .37

THICKNESS SAMPLED:
Feet: 1.2 Meters: .37

TYPE OF SAMPLE: Drill Core: Coal

SAMPLE NUMBER: CFI 29-1 Run 4

ANALYSES LABORATORY NUMBERS
USBM/DOE: 90195
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 0.8 Meters: 0.2

THICKNESS SAMPLED:
Feet: 0.8 Meters: 0.2

TYPE OF SAMPLE: Drill Core: Coal

SAMPLE NUMBER: CFI 29-1 Run 5

ANALYSES LABORATORY NUMBERS:
USBM/DOE: 89074
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 0.9 Meters: 0.27

THICKNESS SAMPLED:
Feet: 0.9 Meters: 0.27

TYPE OF SAMPLE: Drill Core: Coal

RATON MESA REGION
TRINIDAD FIELD

LAS ANIMAS COUNTY

SAMPLE NUMBERS: CFI 29-2 Run 1 upper, lower

COAL BED NAME: Cokedale

GEOLOGIC ROCK UNIT: Vermejo

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 7.25 Meters: 2.2

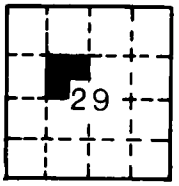
OVERBURDEN AT SAMPLING POINT:
Feet: 868 Meters: 265

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 29

TOWNSHIP: 34 S

RANGE: 63 W

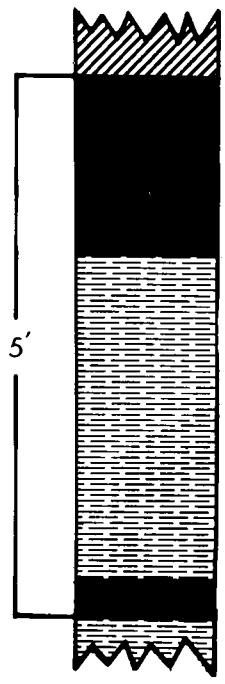
USGS TOPOGRAPHIC QUADRANGLE:
Fisher's Peak 7.5' (1971)

DRILL HOLE: CF&I 29-2

MINE TYPE: --

OPERATOR/OWNER: CF&I Corp.

COKEDALE COAL BED



2.1' COAL: Sample No. CFI 29-2 Run 1 Upper, sparse vitrain stringers in dull attritus.

2.4' CARBONACEOUS SHALE: black, silty, very hard.

0.5' COAL: Sample No. CFI 29-2 Run 1 Lower, dull attritus, shaly.
SHALE: dark gray, occasionally carbonaceous.

SAMPLE NUMBER: CFI 29-2 Run 1 upper

ANALYSES LABORATORY NUMBERS:
USBM/DOE: K88878
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 2.1 Meters: 0.6

THICKNESS SAMPLED:
Feet: 2.1 Meters: 0.6

TYPE OF SAMPLE: Drill Core: Coal

RATON MESA REGION
TRINIDAD FIELD

SAMPLE NUMBER: CFI 29-2 Run 1 lower

ANALYSES LABORATORY NUMBERS
USBM/DOE: K89372
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 0.5 Meters: 0.15

THICKNESS SAMPLED:
Feet: 0.5 Meters: 0.15

TYPE OF SAMPLE: Drill Core: Coal

RATON MESA REGION
TRINIDAD FIELD

LAS ANIMAS COUNTY

SAMPLE NUMBERS: CFI 29-2 Run 3 upper, lower

COAL BED NAME: Piedmont

GEOLOGIC ROCK UNIT: Vermejo Fm

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 4.65 Meters: 1.42

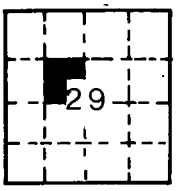
OVERBURDEN AT SAMPLING POINT:
Feet: 961.7 Meters: 293

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 29

TOWNSHIP: 34 S

RANGE: 63 W

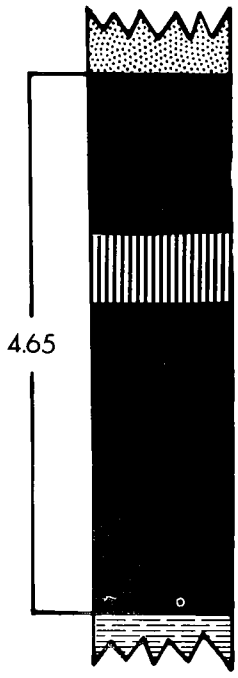
USGS TOPOGRAPHIC QUADRANGLE:
Fisher's Peak 7.5' (1971)

DRILL HOLE: CFI 29-2

MINE TYPE: --

OPERATOR/OWNER: CF&I Corp.

PIEDMONT COAL BED



SANDSTONE: brown to gray, fine to medium grained.

1.5' COAL: Sample No. CFI 29-2 Run 3 Upper, dull to moderately bright attritus, some pyrite.

0.65' SHALY COAL: pyritic.

2.5' COAL: Sample No. CFI 29-2 Run 3 Lower, as above.

CLAYSTONE: dark gray, pyritic.

SAMPLE NUMBER: CFI 29-2 Run 3 upper

ANALYSES LABORATORY NUMBERS:
USBM/DOE: K88879
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 1.5 Meters: 0.5

THICKNESS SAMPLED:
Feet: 1.5 Meters: 0.5

TYPE OF SAMPLE: Drill Core: Coal

SAMPLE NUMBER: CFI 29-2 Run 3 lower

ANALYSES LABORATORY NUMBERS
USBM/DOE: 89024
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 2.5 Meters: 0.76

THICKNESS SAMPLED:
Feet: 2.5 Meters: 0.76

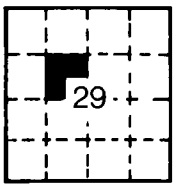
TYPE OF SAMPLE: Drill Core: Coal

RATON MESA REGION
TRINIDAD FIELD

LAS ANIMAS COUNTY

SAMPLE NUMBERS: CFI 29-2 Run 4 Upper, Lower, Run 5, Run 6

LOCATION IN SECTION



COAL BED NAME: Morley

GEOLOGIC ROCK UNIT: Vermejo

SECTION: 29

GEOLOGIC AGE: Cretaceous

TOWNSHIP: 34 S

TOTAL SECTION MEASURED:
Feet: 26.8 Meters: 8.2

RANGE: 63 W

USGS TOPOGRAPHIC QUADRANGLE:
Fisher's Peak 7.5' (1971)

OVERBURDEN AT SAMPLING POINT:
Feet: 1005.5 Meters: 306.5

STRIKE: --

DRILL HOLE: CFI 29-2

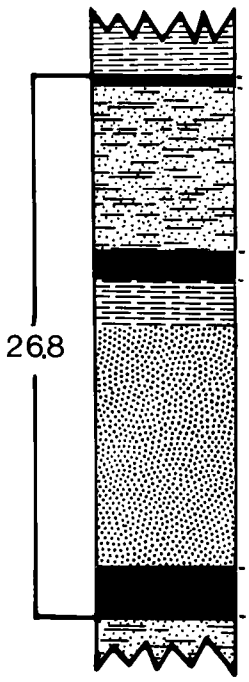
DIP: --

MINE TYPE: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

OPERATOR/OWNER: --

MORLEY COAL BED



CARBONACEOUS SHALE

0.45' COAL: Sample No. CFI 29-2, Run 4 Upper, pyritic.

6.8' INTERBEDDED SANDSTONE AND SHALE

1.6' COAL: Sample No. CFI 29-2 Run 4 Lower, moderate to abundant, thin to medium thick vitrain bands in attritus, poor cleat development.

2.5' CARBONACEOUS SHALE

12.0' SANDSTONE: light gray, very fine grained, grades to claystone at base.

0.9' COAL: Sample No. CFI 29-2 Run 5, moderately abundant thin vitrain bands in attritus.

2.3' COAL: Sample No. CFI 29-2 Run 6, as above.

INTERBEDDED SANDSTONE AND SHALE.

SAMPLE NUMBER: CFI 29-2 Run 4 Upper

ANALYSES LABORATORY NUMBERS
USBM/DOE: K89025
USGS: --

THICKNESS OF COAL:
Feet: 0.45 Meters: 0.14

THICKNESS SAMPLED:
Feet: 0.45 Meters: 0.14

APPARENT RANK OF COAL:
High-volatile B bituminous

TYPE OF SAMPLE: Drill Core: Coal

SAMPLE NUMBER: CFI 29-2 Run 4 Lower

ANALYSES LABORATORY NUMBERS
USBM/DOE: K89042
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 1.6 Meters: 0.49

THICKNESS SAMPLED:
Feet: 1.6 Meters: 0.49

TYPE OF SAMPLE: Drill Core: Coal

SAMPLE NUMBER: CFI 29-2 Run 5

ANALYSES LABORATORY NUMBERS
USBM/DOE: K89026
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 0.9 Meters: 0.3

THICKNESS SAMPLED:
Feet: 0.9 Meters: 0.3

TYPE OF SAMPLE: Drill Core: Coal

SAMPLE NUMBER: CFI 29-2 Run 6

ANALYSES LABORATORY NUMBERS
USBM/DOE: K89027
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 2.3 Meters: 0.7

THICKNESS SAMPLED:
Feet: 2.3 Meters: 0.7

TYPE OF SAMPLE: Drill Core: Coal

CANON CITY FIELD

FREMONT COUNTY

SAMPLE NUMBER: 78-JH-1

COAL BED NAME: Unnamed

GEOLOGIC ROCK UNIT: Vermejo

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: -- Meters: --

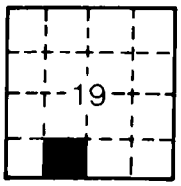
OVERBURDEN AT SAMPLING POINT:
Feet: -- Meters: --

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 19

TOWNSHIP: 20 S

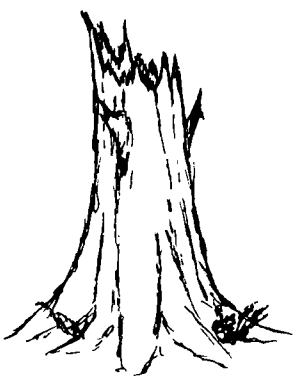
RANGE: 69 W

USGS TOPOGRAPHIC QUADRANGLE:
Rockvale 7.5' (1959)

MINE NAME: Hastings Strip

MINE TYPE: --

OPERATOR/OWNER: --



COAL: Sample No. 78-JH-1, coalified tree stump.

ANALYSES LABORATORY NUMBERS
USBM/DOE: K35453
USGS: D201446

APPARENT RANK OF COAL:
High-volatile C bituminous

THICKNESS OF COAL:
Feet: -- Meters: --

THICKNESS SAMPLED:
Feet: -- Meters: --

TYPE OF SAMPLE: Coal

CANON CITY FIELD

FREMONT COUNTY

SAMPLE NUMBER: 78-JS-1

COAL BED NAME: Little Johnnie

GEOLOGIC ROCK UNIT: Vermejo

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: 2.1 Meters: 0.64

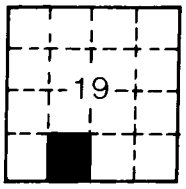
OVERBURDEN AT SAMPLING POINT:
Feet: 40 Meters: 12.2

STRIKE: N 40°E

DIP: 6°

MAJOR CLEAT ORIENTATION IN COAL:
FACE: N 30°E
BUTT: N 65°W

LOCATION IN SECTION



SECTION: 19

TOWNSHIP: 20 S

RANGE: 69 W

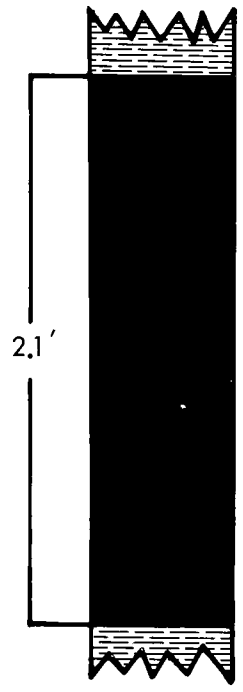
USGS TOPOGRAPHIC QUADRANGLE:
Rockvale 7.5' (1959)

MINE NAME: Hastings Strip

MINE TYPE: Surface

OPERATOR/OWNER: Imogene Hastings

LITTLE JOHNNIE COAL BED



COAL: Sample No. 78-JS-1, banded, vitrain in bright attrital, blocky.

ANALYSES LABORATORY NUMBERS
USBM/DOE: K85448
USGS: D201440

APPARENT RANK OF COAL:
High-volatile C bituminous

THICKNESS OF COAL:
Feet: 2.1 Meters: 0.64

THICKNESS SAMPLED:
Feet: 2.1 Meters: 0.64

TYPE OF SAMPLE: Coal-channel

CANON CITY FIELD

FREMONT COUNTY

SAMPLE NUMBER: 78-JS-2, 4

COAL BED NAME: Little Johnnie

GEOLOGIC ROCK UNIT: Vermejo

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: 4.15 Meters: 1.27

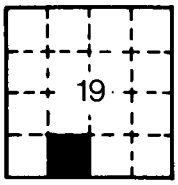
OVERBURDEN AT SAMPLING POINT:
Feet: 70 Meters: 21

STRIKE: N 20°E - 30°E

DIP: 7°SE

MAJOR CLEAT ORIENTATION IN COAL:
Face: N 75°W
Butt: N 10°E

LOCATION IN SECTION



SECTION: 19

TOWNSHIP: 20 S

RANGE: 69 W

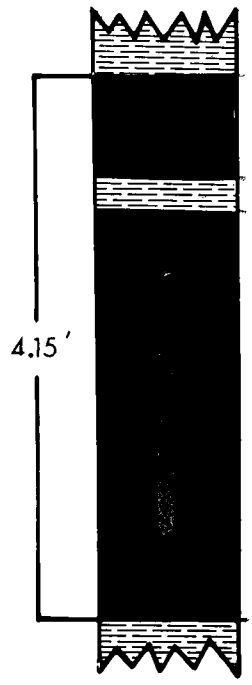
USGS TOPOGRAPHIC QUADRANGLE:
Rockvale 7.5' (1959)

MINE NAME: Hastings Strip

MINE TYPE: Surface

OPERATOR/OWNER: Imogene Hastings

LITTLE JOHNNIE COAL BED



SHALE: buff.

0.8' COAL: Sample No. 78-JS-4, banded, vitrain in attritus, friable, calcite filled cleats, amber present.

0.35' SHALE: sparse coal laminae, band of fine pyrite.

3.0' COAL: Sample No. 78-JS-2, banded, vitrain in bright attritus, blocky, brittle, well defined face and butt cleats, calcite and pyrite in cleats.

CARBONACEOUS SHALE

Sample No. 78-JS-2

ANALYSES LABORATORY NUMBERS
USBM/DOE: K85449
USGS: D201441

APPARENT RANK OF COAL:
High-volatile C bituminous

THICKNESS OF COAL:
Feet: 0.8 Meters: 0.24

THICKNESS SAMPLED:
Feet: 0.8 Meters: 0.24

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: 78-JS-4

ANALYSES LABORATORY NUMBERS
USBM/DOE: K85450
USGS: D201442

APPARENT RANK OF COAL:
High-volatile C bituminous

THICKNESS OF COAL:
Feet: 3.0 Meters: 0.91

THICKNESS SAMPLED:
Feet: 3.0 Meters: 0.91

TYPE OF SAMPLE: Coal-channel

CANON CITY FIELD

FREMONT COUNTY

SAMPLE NUMBER: 78-JS-6

COAL BED NAME: Zenith

GEOLOGIC ROCK UNIT: Vermejo

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: 3.1 Meters: 0.95

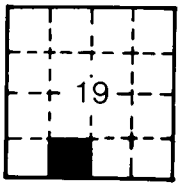
OVERBURDEN AT SAMPLING POINT:
Feet: 20 - 30 Meters: 6.1 - 9.1

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 19

TOWNSHIP: 20 S

RANGE: 69 W

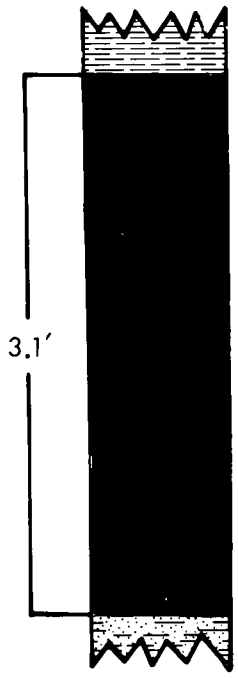
USGS TOPOGRAPHIC QUADRANGLE:
Rockvale 7.5' (1959)

MINE NAME: Hastings Strip

MINE TYPE: Surface

OPERATOR/OWNER: Imogene Hastings

ZENITH COAL BED



SHALE: grading up into sandstone.

COAL: Sample No. 78-JS-6, banded.

SILTY SANDSTONE: white to medium gray.

ANALYSES LABORATORY NUMBERS
USBM/DOE: K85451
USGS: D201444

APPARENT RANK OF COAL:
High-volatile C bituminous

THICKNESS OF COAL:
Feet: 3.1 Meters: 0.95

THICKNESS SAMPLED:
Feet: 3.1 Meters: 0.95

TYPE OF SAMPLE: Coal-channel

CANON CITY FIELD

FREMONT COUNTY

SAMPLE NUMBER: 78-JS-7

COAL BED NAME: Unnamed

GEOLOGIC ROCK UNIT: Vermejo

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 1.3 Meters: 0.4

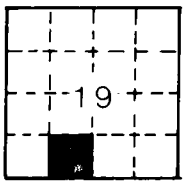
OVERBURDEN AT SAMPLING POINT:
Feet: -- Meters: --

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 19

TOWNSHIP: 20 S

RANGE: 69 W

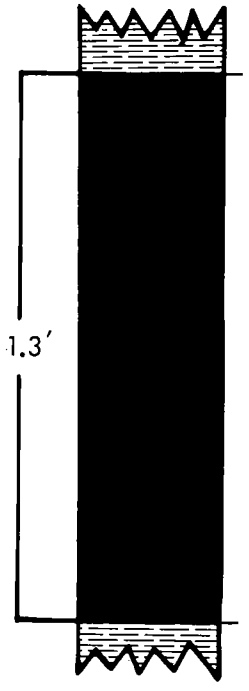
USGS TOPOGRAPHIC QUADRANGLE:
Rockvale 7.5' (1959)

MINE NAME: Roadcut by GEC Mine

MINE TYPE: --

OPERATOR/OWNER: --

COAL BED NAME UNKNOWN



SHALE: dark gray, grades upward into silty sandstone, light gray, silty to medium grained.

COAL: Sample No. 78-JS-7, banded, 15-20% vitrain in attritus, blocky, brittle, pyrite and calcite filled cleats, rare amber throughout.

CLAYSTONE

ANALYSES LABORATORY NUMBERS
USBM/DOE: K85452
USGS: D201445

APPARENT RANK OF COAL:
High-volatile C bituminous

THICKNESS OF COAL:
Feet: 1.3 Meters: 0.4

THICKNESS SAMPLED:
Feet: 1.3 Meters: 0.4

TYPE OF SAMPLE: Coal-channel

Table D1. Proximate and ultimate analyses, heat-of-combustion, forms-of-sulfur, free-swelling-index and ash-fusion-temperature determinations for 31 coal samples from the Raton Mesa Region, Colorado.

[All analyses except heat-of-combustion, free-swelling index, and ash-fusion temperatures in percent. For each sample number, the analyses are reported three ways: first, as received; second, moisture free; and third, moisture and ash free. All analyses by Coal Analysis Section, U.S. Department of Energy, Pittsburgh, Pa. °F = (°C x 1.8) + 32; Kcal/kg = 0.556 (Btu/lb), L, less than the value shown]

	Proximate Analysis				Ultimate Analysis					Heat of Combustion	
Sample number	Moisture	Volatile matter	Fixed carbon	Ash	Hydrogen	Carbon	Nitrogen	Oxygen	Sulfur	Kcal/kg	Btu/lb
D180089	1.4	24.6	46.4	27.6	4.3	59.9	1.4	6.4	0.4	5,920	10,650
	---	24.9	47.1	28.0	4.2	60.8	1.4	5.2	.4	6,000	10,800
	---	34.6	65.4	---	5.8	84.4	2.0	7.3	.6	8,330	15,000
D180090	2.6	17.5	26.6	53.3	3.1	34.9	.8	7.4	.4	3,380	6,080
	---	18.0	27.3	54.7	2.9	35.8	.8	5.2	.4	3,470	6,240
	---	39.7	60.3	---	6.4	79.1	1.8	11.5	.9	7,660	13,790
D180091	1.2	27.0	46.5	25.3	4.4	62.5	1.4	5.5	.9	6,170	11,110
	---	27.3	47.1	25.6	4.3	63.3	1.4	4.5	.9	6,250	11,250
	---	36.7	63.3	---	5.8	85.0	1.9	6.0	1.2	8,400	15,120
D180092	.9	17.2	54.7	27.2	2.8	62.2	1.2	5.8	.8	5,650	10,170
	---	17.4	55.2	27.4	2.7	62.8	1.2	5.0	.8	5,700	10,260
	---	23.9	76.1	---	3.8	86.5	1.7	7.0	1.1	7,860	14,140
D184634	7.5	37.0	44.4	11.1	5.5	64.4	1.2	17.2	.7	6,320	11,380
	---	40.0	48.0	12.0	5.0	69.6	1.3	11.4	.8	6,830	12,300
	---	45.5	54.5	---	5.7	79.1	1.5	12.9	.9	7,770	13,980
D184635	6.8	36.4	43.8	13.0	5.3	63.2	1.2	16.7	.6	6,160	11,080
	---	39.1	47.0	13.9	4.9	67.8	1.3	11.4	.6	6,610	11,890
	---	45.4	54.6	---	5.7	78.8	1.5	13.3	.7	7,680	13,820
D201440	9.2	36.2	47.9	6.7	5.9	65.0	1.1	19.5	1.7	6,430	11,580
	---	39.9	52.8	7.4	5.4	71.6	1.2	12.5	1.9	7,090	12,760
	---	43.0	57.0	---	5.8	77.3	1.3	13.5	2.0	7,650	13,770
D201441	9.7	37.2	48.0	5.1	5.9	65.5	1.1	21.4	1.0	6,480	11,670
	---	41.2	53.2	5.6	5.3	72.5	1.2	14.2	1.1	7,180	12,920
	---	43.7	56.3	---	5.7	76.9	1.3	15.0	1.2	7,610	13,690
D201442	8.7	37.3	44.0	10.0	5.6	62.4	1.0	19.0	1.9	6,170	11,110
	---	40.9	48.2	11.0	5.1	68.3	1.1	12.3	2.1	6,760	12,170
	---	45.9	54.1	---	5.7	76.8	1.2	13.9	2.3	7,590	13,660
D201444	9.7	36.5	49.6	4.2	5.5	65.3	1.2	22.9	.9	6,320	11,370
	---	40.4	54.9	4.7	4.9	72.3	1.3	15.8	1.0	7,000	12,590
	---	42.4	57.6	---	5.1	75.8	1.4	16.6	1.0	7,340	13,210
D201445	10.5	32.8	46.2	10.5	5.4	61.4	1.2	20.8	.7	6,000	10,800
	---	36.6	51.6	11.7	4.7	68.6	1.3	12.8	.8	6,710	12,070
	---	41.5	58.5	---	5.4	77.7	1.5	14.5	.9	7,600	13,680

Table D1. Proximate and ultimate analyses, heat-of-combustion, forms-of-sulfur, free-swelling-index and ash-fusion-temperature determinations for 31 coal samples from the Raton Mesa Region, Colorado (cont.).

Sample number	Air-dried loss	Forms of sulfur			Free swelling	Ash fusion temperature C		
		Sulfate	Pyritic	Organic		Initial deformation	softening	fluid
D180089	0.4	0.01L	0.05	0.39	6.0	1,540	1,540	1,540
	---	.01L	.05	.40				
	---	.01L	.07	.55				
D180090	.9	.01	.15	.28	1.0	1,540	1,540	1,540
	---	.01	.15	.29				
	---	.02	.34	.63				
D180091	.2	.09	.37	.47	7.0	1,365	1,410	1,455
	---	.09	.37	.48				
	---	.12	.50	.64				
D180092	B	.01	.33	.41	.0	1,230	1,290	1,330
	---	.01	.33	.41				
	---	.01	.46	.57				
D184634	3.0	.02	.07	.56	.0	1,430	1,490	1,540
	---	.02	.08	.61				
	---	.02	.09	.69				
D184635	1.9	.01	.09	.48	.0	1,370	1,420	1,470
	---	.01	.10	.52				
	---	.01	.11	.60				
D201440	3.5	.01	.25	1.41	.0	1,235	1,290	1,345
	---	.01	.28	1.55				
	---	.01	.30	1.68				
D201441	3.6	.01	.18	.81	.0	1,150	1,205	1,270
	---	.01	.20	.90				
	---	.01	.21	.95				
D201442	3.5	.01	.68	1.26	.0	1,095	1,155	1,210
	---	.01	.74	1.38				
	---	.01	.84	1.55				
D201444	3.4	.01	.10	.83	.0	1,230	1,290	1,350
	---	.01	.11	.92				
	---	.01	.12	.96				
D201445	4.6	.01	.09	.60	.0	1,345	1,405	1,460
	---	.01	.10	.67				
	---	.01	.11	.76				

Table D1. Proximate and ultimate analyses, heat-of-combustion, forms-of-sulfur, free-swelling-index and ash-fusion-temperature determinations for 31 coal samples from the Raton Mesa Region, Colorado (cont.).

Sample number	Proximate Analysis				Ultimate Analysis					Heat of Combustion	
	Moisture	Volatile matter	Fixed carbon	Ash	Hydrogen	Carbon	Nitrogen	Oxygen	Sulfur	Kcal/kg	Btu/lb
D201446	9.5	31.4	49.5	9.6	5.1	62.9	0.7	20.8	0.9	6,070	10,930
	---	34.7	54.7	10.6	4.5	69.5	.8	13.7	1.0	6,710	12,080
	---	38.8	61.2	---	5.0	77.8	.9	15.3	1.1	7,510	13,520
D201447	2.1	33.8	53.3	10.8	5.3	74.5	1.7	7.3	.4	7,450	13,400
	---	34.5	54.4	11.0	5.2	76.1	1.7	5.5	.4	7,610	13,690
	---	38.8	61.2	---	5.8	85.5	2.0	6.2	.5	8,550	15,390
D201448	2.3	33.2	53.6	10.7	5.4	74.8	1.6	7.1	.4	7,420	13,350
	---	34.0	55.1	11.0	5.3	76.6	1.6	5.2	.4	7,590	13,660
	---	38.2	61.8	---	5.9	86.0	1.8	5.8	.5	8,520	15,340
D201449	1.8	34.6	53.6	10.0	5.3	75.4	1.7	7.1	.4	7,520	13,540
	---	35.2	54.6	10.2	5.2	76.8	1.7	5.6	.4	7,660	13,790
	---	39.2	60.8	---	5.8	85.5	1.9	6.2	.5	8,530	15,350
D201450	2.0	39.4	51.1	7.5	5.7	77.4	1.7	7.3	.4	7,680	13,830
	---	40.2	52.1	7.7	5.6	79.0	1.7	5.6	.4	7,840	14,110
	---	43.5	56.5	---	6.1	85.5	1.9	6.1	.4	8,490	15,280
D201451	2.2	40.6	50.0	7.2	5.9	76.7	1.7	8.0	.5	7,710	13,870
	---	41.5	51.1	7.4	5.8	78.4	1.7	6.2	.5	7,880	14,180
	---	44.8	55.2	---	6.2	84.7	1.9	6.7	.6	8,510	15,310
D205218	4.8	21.9	23.2	50.1	3.7	33.3	.8	11.4	.8	3,270	5,890
	---	23.0	24.4	52.6	3.3	35.0	.8	7.5	.8	3,440	6,190
	---	48.6	51.4	---	7.0	73.8	1.8	15.8	1.8	7,260	13,060
D205219	2.4	33.8	51.8	12.0	5.0	71.1	1.4	9.9	.6	6,940	12,500
	---	34.6	53.1	12.3	4.8	72.8	1.4	8.0	.6	7,110	12,810
	---	39.5	60.5	---	5.5	83.1	1.6	9.1	.7	8,110	14,600
D205220	2.1	39.7	48.7	9.5	5.7	73.2	1.5	9.5	.5	7,330	13,200
	---	40.6	49.7	9.7	5.6	74.8	1.5	7.8	.5	7,490	13,480
	---	44.9	55.1	---	6.2	82.8	1.7	8.6	.6	8,300	14,930
D205221	2.1	37.3	49.4	11.2	5.3	70.4	1.5	11.0	.6	7,050	12,690
	---	38.1	50.5	11.4	5.2	71.9	1.5	9.3	.6	7,200	12,970
	---	43.0	57.0	---	5.8	81.2	1.7	10.5	.7	8,130	14,640
D205222	2.5	37.8	50.7	9.0	5.6	72.2	1.5	11.1	.6	7,180	12,930
	---	38.8	52.0	9.2	5.5	74.1	1.5	9.1	.6	7,370	13,260
	---	42.7	57.3	---	6.0	81.6	1.7	10.0	.7	8,120	14,610
D205223	2.0	36.4	43.8	17.8	5.1	65.2	1.4	10.0	.5	6,550	11,790
	---	37.1	44.7	18.2	5.0	66.5	1.4	8.4	.5	6,680	12,030
	---	45.4	54.6	---	6.1	81.3	1.7	10.3	.6	8,160	14,700

Table D1. Proximate and ultimate analyses, heat-of-combustion, forms-of-sulfur, free-swelling-index and ash-fusion-temperature determinations for 31 coal samples from the Raton Mesa Region, Colorado (cont.).

Sample number	Air-dried loss	Forms of sulfur			Free swelling	Ash fusion temperature C		
		Sulfate	Pyritic	Organic		Initial deformation	softening	fluid
D201446	3.2	0.01	0.21	0.67	0.0	1,600	1,600	1,600
	---	.01	.23	.74				
	---	.01	.26	.83				
D201447	1.1	.01	.08	.31	8.5	1,235	1,295	1,345
	---	.01	.08	.32				
	---	.01	.09	.36				
D201448	1.4	.01	.06	.36	8.5	1,270	1,320	1,380
	---	.01	.06	.37				
	---	.01	.07	.41				
D201449	.8	.01	.04	.39	8.5	1,290	1,345	1,400
	---	.01	.04	.40				
	---	.01	.05	.44				
D201450	.8	.01	.08	.35	8.0	1,125	1,180	1,240
	---	.01	.08	.36				
	---	.01	.09	.39				
D201451	1.0	.01	.06	.39	8.5	1,125	1,180	1,235
	---	.01	.06	.40				
	---	.01	.07	.43				
D205218	3.1	.01	.42	.34	1.0	1,600	1,600	1,600
	---	.01	.44	.36				
	---	.02	.93	.75				
D205219	.9	.01	.17	.38	4.5	1,600	1,600	1,600
	---	.01	.17	.39				
	---	.01	.20	.44				
D205220	.6	.01	.09	.45	3.5	1,295	1,345	1,405
	---	.01	.09	.46				
	---	.01	.10	.51				
D205221	.7	.01	.07	.54	4.5	1,345	1,405	1,455
	---	.01	.07	.55				
	---	.01	.08	.62				
D205222	.9	.01	.09	.50	6.0	1,430	1,490	1,600
	---	.01	.09	.51				
	---	.01	.10	.56				
D205223	.7	.01	.08	.42	4.0	1,425	1,490	1,600
	---	.01	.08	.43				
	---	.01	.10	.52				

Table D1. Proximate and ultimate analyses, heat-of-combustion, forms-of-sulfur, free-swelling-index and ash-fusion-temperature determinations for 31 coal samples from the Raton Mesa Region, Colorado (cont.).

Sample number	Proximate Analysis				Ultimate Analysis					Heat of Combustion	
	Moisture	Volatile matter	Fixed carbon	Ash	Hydrogen	Carbon	Nitrogen	Oxygen	Sulfur	Kcal/kg	Btu/lb
D205224	2.3	38.7	48.4	10.6	5.5	71.0	1.5	10.7	0.6	7,080	12,750
	---	39.6	49.5	10.8	5.4	72.7	1.5	8.9	.6	7,250	13,050
	---	44.4	55.6	---	6.0	81.5	1.7	9.9	.7	8,130	14,640
D205225	2.1	40.0	49.9	8.0	5.7	73.9	1.6	10.2	.6	7,360	13,250
	---	40.9	51.0	8.2	5.6	75.5	1.6	8.5	.6	7,520	13,530
	---	44.5	55.5	---	6.1	82.2	1.8	9.3	.7	8,190	14,730
D205226	2.3	35.0	45.0	17.7	5.0	64.1	1.4	11.2	.6	6,380	11,480
	---	35.8	46.1	18.1	4.9	65.6	1.4	9.4	.6	6,530	11,750
	---	43.7	56.2	---	5.9	80.1	1.7	11.4	.7	7,970	14,350
D205227	2.2	33.3	47.3	17.2	5.0	65.2	1.3	10.7	.6	6,440	11,600
	---	34.0	48.4	17.6	4.9	66.7	1.3	8.9	.6	6,590	11,860
	---	41.3	58.7	---	5.9	80.9	1.6	10.8	.7	8,000	14,390
D205228	2.2	33.7	49.8	14.3	5.3	68.4	1.4	10.1	.6	6,750	12,140
	---	34.5	50.9	14.6	5.2	69.9	1.4	8.3	.6	6,900	12,420
	---	40.4	59.6	---	6.1	81.9	1.7	9.8	.7	8,080	14,540
D205230	1.9	30.7	35.8	31.6	4.5	53.6	1.2	8.3	.8	5,400	9,720
	---	31.3	36.5	32.2	4.4	54.6	1.2	6.7	.8	5,500	9,900
	---	46.2	53.8	---	6.4	80.6	1.8	9.9	1.2	8,120	14,610
D205231	2.2	29.4	38.0	30.4	4.6	55.1	1.2	8.0	.6	5,390	9,700
	---	30.1	38.9	31.1	4.5	56.3	1.2	6.2	.6	5,510	9,920
	---	43.6	56.4	---	6.5	81.8	1.8	9.0	.9	8,000	14,390
D205232	2.4	33.4	47.8	16.4	4.9	66.7	1.2	10.2	.6	6,610	11,910
	---	34.2	49.0	16.8	4.7	68.3	1.2	8.3	.6	6,780	12,200
	---	41.1	58.9	---	5.7	82.1	1.5	9.9	.7	8,150	14,660

Table D1. Proximate and ultimate analyses, heat-of-combustion, forms-of-sulfur, free-swelling-index and ash-fusion-temperature determinations for 31 coal samples from the Raton Mesa Region, Colorado (cont.).

Sample number	Air-dried loss	Forms of sulfur			Free swelling	Ash fusion temperature C		
		Sulfate	Pyritic	Organic		Initial deformation	softening	fluid
D205224	0.7	0.01	0.09	0.50	4.5	1,495	1,600	1,600
	---	.01	.09	.51				
	---	.01	.10	.57				
D205225	.6	.01	.10	.54	4.5	1,295	1,345	1,405
	---	.01	.10	.55				
	---	.01	.11	.60				
D205226	.8	.01	.09	.54	3.5	1,600	1,600	1,600
	---	.01	.09	.55				
	---	.01	.11	.67				
D205227	.8	.01	.13	.48	3.5	1,510	1,600	1,600
	---	.01	.13	.49				
	---	.01	.16	.60				
D205228	.7	.01	.16	.41	2.5	1,515	1,600	1,600
	---	.01	.16	.42				
	---	.01	.19	.49				
D205230	.8	.01	.31	.47	2.5	1,375	1,435	1,485
	---	.01	.32	.48				
	---	.02	.47	.71				
D205231	1.0	.01	.17	.38	2.0	1,375	1,425	1,490
	---	.01	.17	.39				
	---	.01	.25	.56				
D205232	1.1	.01	.22	.34	2.5	1,265	1,325	1,375
	---	.01	.23	.35				
	---	.01	.27	.42				

Table D2. Major- and minor-oxide and trace element composition of the laboratory ash of 33 coal and coal-associated rock samples from the Raton Mesa Region, Colorado.

[Values in percent or parts per million. Coal and shale ashed at 525°C. S after element title indicates determinations by semiquantitative emission spectrography. The spectrographic results are to be identified with geometric brackets whose boundaries are part of the ascending series 0.12, 0.18, 0.26, 0.38, 1.2, etc. but reported as midpoints of the brackets, 0.1, 0.15, 0.2, 0.3, 0.5, 0.7, 1.0, etc. Precision of the spectrographic data is plus-or-minus one bracket at 68 percent or plus-or-minus two brackets at 95 percent confidence level. L, less than the value shown; N, not detected].

Sample number	Ash (percent)	SiO2 (percent)	Al2O3 (percent)	CaO (percent)	MgO (percent)	Na2O (percent)	K2O (percent)	Fe2O3 (percent)	TiO2 (percent)	P2O5 (percent)	Sample number
D180089	30.4	55	27	3.2	1.33	0.56	1.2	3.2	1.1	1.0L	D180089
D180090	57.0	59	26	1.2	1.29	.57	1.7	3.0	.97	1.0L	D180090
D180091	27.5	41	22	11	1.35	.37	.68	5.6	.97	1.3	D180091
D180092	30.3	33	19	9.3	1.87	.39	.71	14	.86	1.3	D180092
D188241	88.2	64	17	4.3	.76	2.23	1.7	4.3	.81	1.0L	D188241
D188242	90.1	71	17	2.7	.28	1.96	1.9	2.3	.58	1.0L	D188242
D184634	12.9	57	21	6.5	.45	.59	.34	3.4	.93	1.0L	D184634
D184635	14.4	49	21	13	.43	1.01	.32	3.0	1.2	1.0L	D184635
D201440	7.7	54	16	10	.58	.41	.24	7.3	.82	.13L	D201440
D201441	6.5	26	10	31	.63	.63	.070	7.0	.50	.15L	D201441
D201442	10.7	43	15	17	.50	.45	.24	10	.82	.090L	D201442
D201444	4.3	43	17	11	.85	.15	.020L	11	.77	.23L	D201444
D201445	11.5	68	13	5.9	.45	.95	.24	4.0	.72	.090L	D201445
D201446	9.1	71	1.9	13	.17	.35	.020L	5.3	.050L	.11L	D201446
D201447	11.7	34	21	18	2.76	1.05	.12	6.9	1.6	2.7	D201447
D201448	10.9	30	21	20	3.15	1.20	.11	6.0	1.5	2.4	D201448
D201449	11.0	34	21	17	2.98	1.23	.12	6.3	1.7	2.4	D201449
D201450	8.7	26	18	22	3.17	1.39	.040	9.7	1.5	2.3	D201450
D201451	7.7	30	19	17	3.48	1.50	.11	11	1.8	2.2	D201451
D205218	51.5	56	28	.42	1.33	.23	1.7	3.7	1.2	.040	D205218
D205219	12.9	26	18	25	1.29	.69	.020L	6.9	.92	3.9	D205219
D205220	9.8	32	23	15	1.56	1.10	.10	7.3	1.6	3.7	D205220
D205221	11.3	54	26	2.5	1.08	.12	.12	6.9	2.7	.090	D205221
D205222	9.9	45	32	2.8	1.33	.23	.11	8.3	1.7	.10L	D205222
D205223	21.6	73	14	1.7	.56	.14	.24	2.1	2.0	.050L	D205223
D205224	11.0	47	30	3.2	1.09	.27	.24	5.4	2.2	.090L	D205224
D205225	8.5	47	28	3.2	1.39	.23	.070	8.7	1.7	.12	D205225
D205226	18.4	51	34	2.1	.68	.09	.12	3.4	1.8	.16	D205226
D205227	18.2	56	26	1.7	.93	.04	.12	3.9	3.2	.66	D205227
D205228	14.5	49	30	3.2	.86	.19	.32	4.6	2.0	2.1	D205228
D205230	32.2	51	26	5.3	1.13	.14	.90	5.2	1.2	1.2	D205230
D205231	34.4	51	26	5.6	1.39	.19	.96	4.2	1.5	.76	D205231
D205232	16.6	41	25	12	1.18	.34	.58	7.2	1.2	.060L	D205232

Table D2. Major- and minor-oxide and trace element composition of the laboratory ash of 33 coal and coal-associated rock samples from the Raton Mesa Region, Colorado (cont.).

Sample number	SO3 (percent)	B-S (ppm)	Ba-S (ppm)	Be-S (ppm)	Cd (ppm)	Co-S (ppm)	Cr-S (ppm)	Cu (ppm)	Ga-S (ppm)	Ge-S (ppm)	Sample number
D180089	0.93	70	1,500	7	1.0L	10	100	131	50	N	D180089
D180090	.86	50	1,000	5	1.0L	10L	70	93	50	N	D180090
D180091	5.5	50	1,500	3	1.0L	10L	70	126	30	N	D180091
D180092	4.0	50L	1,000	3	1.0L	10L	30	74	30	N	D180092
D188241	.41	N	1,500	N	1.0L	15	30	53	15	N	D188241
D188242	.29	N	1,000	N	1.0L	7	15	20L	15	N	D188242
D184634	5.3	300	700	7	1.0	B	B	77	20	N	D184634
D184635	5.5	500	700	7	1.0L	B	B	43	30	N	D184635
D201440	9.3	300	1,500	15	1.0	B	B	96	20	20	D201440
D201441	17	500	2,000	7	1.0L	B	B	58	15	N	D201441
D201442	9.5	300	1,500	15	1.0L	B	B	58	30	N	D201442
D201444	12	700	2,000	30	1.0L	B	B	96	30	30	D201444
D201445	5.0	300	1,000	20	1.0L	B	B	55	20	30	D201445
D201446	9.3	500	1,000	N	1.0L	B	B	20L	N	N	D201446
D201447	4.5	150	5,000	N	1.0L	B	B	162	70	N	D201447
D201448	4.0	150	5,000	N	1.0L	B	B	148	70	N	D201448
D201449	3.0	150	5,000	N	1.0L	B	B	160	50	N	D201449
D201450	6.3	200	5,000	N	1.0L	B	B	113	30	N	D201450
D201451	6.3	200	5,000	3	1.0L	B	B	141	30	N	D201451
D205218	.25	70	700	3	1.0L	B	B	93	50	N	D205218
D205219	5.3	150	7,000	3	1.0L	B	B	126	30	N	D205219
D205220	3.8	200	7,000	10	1.0L	B	B	224	50	N	D205220
D205221	1.9	150	1,500	20	1.0L	B	B	152	70	N	D205221
D205222	1.5	150	1,500	20	1.0L	B	B	75	50	N	D205222
D205223	1.8	100	1,000	3	1.0L	B	B	82	30	N	D205223
D205224	1.8	150	1,500	10	1.0L	B	B	74	50	N	D205224
D205225	2.4	150	1,500	15	1.0L	B	B	107	50	N	D205225
D205226	.50	100	1,000	7	1.0L	B	B	151	70	N	D205226
D205227	1.0	100	1,000	7	1.0L	B	B	102	70	N	D205227
D205228	.90	150	2,000	7	1.0L	B	B	72	50	N	D205228
D205230	.75	70	3,000	7	1.0	B	B	160	70	N	D205230
D205231	.50	70	2,000	7	1.0L	B	B	197	50	N	D205231
D205232	1.9	100	1,500	7	1.0L	B	B	175	30	N	D205232

Table D2. Major- and minor-oxide and trace element composition of the laboratory ash of 33 coal and coal-associated rock samples from the Raton Mesa Region, Colorado (cont.).

Sample number	La-S (ppm)	Li (ppm)	Mn (ppm)	Mo-S (ppm)	Nb-S (ppm)	Nd-S (ppm)	Ni-S (ppm)	Pb (ppm)	Sc-S (ppm)	Sr-S (ppm)	Sample number
D180089	100	105	90	15	30	150	30	40	20	1,000	D180089
D180090	100L	72	100	7	20	N	20	35	15	500	D180090
D180091	100L	105	225	15	20	N	30	30	15	700	D180091
D180092	100L	80	1,490	7	20	N	30	25L	15	700	D180092
D188241	N	15	165	N	20	N	10	25L	15	700	D188241
D188242	N	23	170	N	N	N	5	25L	7	500	D188242
D184634	100L	45	130	7	50	150L	50	90	15	700	D184634
D184635	100	76	590	7	30	N	30	50	15	500	D184635
D201440	100L	29	660	10	N	N	100	29	15	1,500	D201440
D201441	100L	20	1,950	7L	N	N	30	25L	10	2,000	D201441
D201442	N	38	490	7	N	B	30	25L	15	2,000	D201442
D201444	100L	32	300	7	N	N	100	25L	15	2,000	D201444
D201445	N	32	300	N	N	B	30	25L	15	1,000	D201445
D201446	N	14	620	N	N	B	N	25L	N	1,000	D201446
D201447	100L	107	125	15	20	N	30	25L	30	3,000	D201447
D201448	100L	110	96	15	30	N	50	30	30	3,000	D201448
D201449	100L	116	83	15	30	N	70	25L	30	2,000	D201449
D201450	100L	57	160	15	20	N	70	25	15	3,000	D201450
D201451	100L	64	165	15	20	N	100	25L	15	3,000	D201451
D205218	100L	80	71	7	30	N	30	36	30	200	D205218
D205219	100L	65	398	7	30	N	20	25L	15	7,000	D205219
D205220	100L	61	215	7	50	N	30	38	50	3,000	D205220
D205221	150	92	137	30	70	150	100	64	50	500	D205221
D205222	150	149	164	20	50	150	70	32	30	500	D205222
D205223	N	157	159	N	30	B	10L	58	15	200	D205223
D205224	100L	64	71	10	70	N	30	49	30	500	D205224
D205225	150	131	91	30	30	150	100	51	30	500	D205225
D205226	N	91	150	15	50	B	30	51	30	300	D205226
D205227	150	213	63	15	70	150	30	61	30	1,000	D205227
D205228	100L	139	80	15	70	N	30	63	30	2,000	D205228
D205230	150	103	79	15	50	150	70	53	50	2,000	D205230
D205231	150	102	161	10	50	150	50	41	30	1,000	D205231
D205232	100	86	730	15	30	N	50	34	30	1,000	D205232

Table D2. Major- and minor-oxide and trace element composition of the laboratory ash of 33 coal and coal-associated rock samples from the Raton Mesa Region, Colorado (cont.).

Sample number	V-S (ppm)	Y-S (ppm)	Yb-S (ppm)	Zn (ppm)	Zr-S (ppm)
D180089	300	70	7	83	150
D180090	300	30	7	113	100
D180091	300	50	7	81	70
D180092	150	50	7	69	150
D188241	70	30	3	100	300
D188242	30	10	2	37	200
D184634	70	70	7	90	150
D184635	70	70	7	48	200
D201440	150	200	15	53	100
D201441	70	150	10	20L	100
D201442	150	150	15	45	100
D201444	150	300	20	50	100
D201445	70	150	10	23	150
D201446	N	20	2L	20L	N
D201447	200	50	5	26	150
D201448	200	50	5	29	150
D201449	200	50	5	22	150
D201450	150	50	5	25	150
D201451	150	50	5	26	150
D205218	200	70	7	62	200
D205219	150	70	5	30	200
D205220	200	50	7	10	200
D205221	200	300	20	167	300
D205222	200	200	15	43	300
D205223	100	70	7	44	500
D205224	200	70	7	15	300
D205225	150	200	15	12	200
D205226	150	70	7	95	300
D205227	300	100	10	69	300
D205228	200	70	7	56	300
D205230	300	150	15	131	150
D205231	200	100	7	118	150
D205232	150	100	7	105	200

Table D3. Content of 9 trace elements in 33 coal and coal-associated rock samples from the Raton Mesa Region, Colorado.

[Analyses on air-dried (32°C) coal and shale. L, less than the value shown]

Sample number	As (ppm)	Co (ppm)	Cr (ppm)	F (ppm)	Hg (ppm)	Sb (ppm)	Se (ppm)	Th (ppm)	U (ppm)	Sample number
D180089	1.0	B	B	100	0.07	0.5	2.4	7.7	3.5	D180089
D180090	2.5	B	B	1,390	.12	.7	2.4	13	4.6	D180090
D180091	5.5	B	B	340	.32	.7	3.0	4.6	2.5	D180091
D180092	1.0	B	B	155	.17	.4	2.5	6.8	2.3	D180092
D188241	2.0	B	B	430	.07	1.0	.6	7.0	4.0	D188241
D188242	1.0	B	B	190	.06	.6	.3	3.9	2.3	D188242
D184634	1.1	7.5	4.0	45	.03	.2	1.9	5.3	2.2	D184634
D184635	1.4	2.9	3.7	30	.05	.3	B	4.6	1.7	D184635
D201440	1.6	7.5	2.6	20	.09	.1	1.3	.9	.4	D201440
D201441	.7	3.2	1.3	20L	.03	.1L	.9	.4	.2	D201441
D201442	1.8	1.7	3.1	20	.16	.1	1.3	1.0	.5	D201442
D201444	1.3	3.6	1.7	20L	.06	.1	1.1	.5	.4	D201444
D201445	.7	9.4	2.8	20L	.01	.3	1.1	1.3	.5	D201445
D201446	.3	.9	.2	20L	.02	.1L	.3	.1L	.2L	D201446
D201447	.7	1.4	8.0	75	.06	.3	2.6	3.3	1.3	D201447
D201448	.7	.1L	.1L	60	.03	.1L	.1L	.1L	1.1	D201448
D201449	.8	1.7	8.0	60	.07	.2	2.5	3.5	1.4	D201449
D201450	.8	2.4	3.3	55	.04	.1	3.0	2.0	.6	D201450
D201451	.8	2.5	3.9	45	.05	.1	3.4	2.2	.7	D201451
D205218	2.3	7.4	38	280	.12	.7	4.1	11	4.4	D205218
D205219	.3	1.2	3.7	95	.03	.2	1.9	3.3	1.3	D205219
D205220	.5	2.4	8.4	80	.05	.2	2.7	4.2	1.6	D205220
D205221	.3	5.5	5.9	40	.03	.4	4.9	3.1	1.1	D205221
D205222	.3	6.9	1.8	40	.02	.2	1.5	1.9	.6	D205222
D205223	.6	2.3	4.0	45	.03	.3	3.9	5.1	1.9	D205223
D205224	.6	3.7	1.8	45	.03	.2	2.7	3.4	.9	D205224
D205225	.3	5.2	3.5	30	.05	.4	2.6	2.0	.7	D205225
D205226	.5	4.2	4.4	60	.04	.3	4.3	4.7	1.7	D205226
D205227	1.0	3.3	6.5	110	.06	.4	4.2	5.7	1.9	D205227
D205228	1.9	3.2	6.0	210	.07	.3	4.3	6.0	2.0	D205228
D205230	2.9	7.4	37	240	.42	.8	2.5	10	5.3	D205230
D205231	3.3	6.0	38	190	.09	.7	2.7	9.9	4.4	D205231
D205232	1.7	2.9	11	55	.09	.3	2.4	4.8	2.1	D205232

Table D4. Major-, minor- and trace-element composition of 33 coal and coal-associated rock samples from the Raton Mesa Region, Colorado.

[Values in percent or parts per million. As, Co, Cr, F, Hg, Sb, Se, Th, and U values are from direct determinations on air-dried (32°C) coal and shale; all other values calculated from analyses of ash. S means analysis by emission spectrography; L, less than the value shown; N, not detected].

Sample number	Si (percent)	Al (percent)	Ca (percent)	Mg (percent)	Na (percent)	K (percent)	Fe (percent)	Ti (percent)	As (ppm)	B-S (ppm)	Sample number
D180089	7.9	4.3	0.69	0.24	0.13	0.29	0.67	0.21	1.0	20	D180089
D180090	16	7.7	.48	.44	.24	.80	1.2	.33	2.5	30	D180090
D180091	5.3	3.3	2.1	.22	.075	.16	1.1	.16	5.5	15	D180091
D180092	4.6	3.1	2.0	.34	.088	.18	3.0	.16	1.0	15L	D180092
D188241	26	7.9	2.7	.40	1.5	1.2	2.7	.43	2.0	N	D188241
D188242	30	8.1	1.7	.15	1.3	1.4	1.4	.31	1.0	N	D188242
D184634	3.4	1.4	.60	.035	.056	.037	.31	.072	1.1	50	D184634
D184635	3.3	1.6	1.3	.037	.11	.038	.30	.10	1.4	70	D184635
D201440	1.9	.64	.56	.027	.023	.015	.39	.038	1.6	20	D201440
D201441	.78	.34	1.4	.025	.030	.004	.32	.019	.7	30	D201441
D201442	2.1	.83	1.3	.032	.036	.021	.76	.053	1.8	30	D201442
D201444	.86	.38	.33	.022	.005	.001L	.34	.020	1.3	30	D201444
D201445	3.7	.80	.48	.031	.081	.023	.32	.050	.7	30	D201445
D201446	3.0	.091	.83	.009	.024	.002L	.34	.003L	.3	50	D201446
D201447	1.9	1.3	1.5	.19	.091	.012	.56	.11	.7	15	D201447
D201448	1.5	1.2	1.5	.21	.097	.010	.46	.096	.7	15	D201448
D201449	1.8	1.2	1.3	.20	.10	.011	.48	.11	.8	15	D201449
D201450	1.0	.81	1.4	.17	.090	.003	.59	.078	.8	15	D201450
D201451	1.1	.77	.92	.16	.086	.007	.59	.085	.8	15	D201451
D205218	14	7.7	.15	.41	.088	.72	1.3	.38	2.3	30	D205218
D205219	1.5	1.2	2.3	.10	.066	.002L	.62	.071	.3	20	D205219
D205220	1.5	1.2	1.1	.092	.080	.008	.50	.095	.5	20	D205220
D205221	2.8	1.6	.20	.073	.010	.011	.54	.18	.3	15	D205221
D205222	2.1	1.7	.20	.079	.017	.009	.57	.099	.3	15	D205222
D205223	7.4	1.6	.26	.073	.022	.043	.32	.26	.6	20	D205223
D205224	2.4	1.8	.25	.072	.022	.022	.42	.14	.6	15	D205224
D205225	1.9	1.3	.20	.071	.014	.005	.52	.085	.3	15	D205225
D205226	4.4	3.3	.28	.075	.012	.018	.44	.20	.5	20	D205226
D205227	4.9	2.5	.22	.10	.005	.018	.49	.35	1.0	20	D205227
D205228	3.3	2.3	.33	.075	.020	.039	.46	.17	1.9	20	D205228
D205230	7.7	4.5	1.2	.22	.033	.24	1.2	.23	2.9	20	D205230
D205231	8.3	4.8	1.4	.29	.048	.28	1.0	.30	3.3	20	D205231
D205232	3.2	2.2	1.4	.12	.042	.080	.83	.12	1.7	15	D205232

Table D4. Major-, minor- and trace-element composition of 33 coal and coal-associated rock samples from the Raton Mesa Region, Colorado (cont.).

Sample number	Ba-S (ppm)	Be-S (ppm)	Cd (ppm)	Co (ppm)	Cr (ppm)	Cu (ppm)	F (ppm)	Ga-S (ppm)	Ge-S (ppm)	Hg (ppm)	Sample number
D180089	500	2	0.30L	3.0	30	40	100	15	N	0.07	D180089
D180090	700	3	.57L	7L	50	53	1,390	30	N	.12	D180090
D180091	500	.7	.28L	3L	20	35	340	7	N	.32	D180091
D180092	300	1	.30L	3L	10	22	155	10	N	.17	D180092
D188241	1,500	N	.88L	15	30	47	430	15	N	.07	D188241
D188242	1,000	N	.90L	7.0	15	18L	190	15	N	.06	D188242
D184634	100	1	.13	7.5	4.0	9.9	45	2	N	.03	D184634
D184635	100	1	.14L	2.9	3.7	6.2	30	5	N	.05	D184635
D201440	100	1	.08	7.5	2.6	7.4	20	1.5	1.5	.09	D201440
D201441	150	.5	.07L	3.2	1.3	3.8	20L	1	N	.03	D201441
D201442	150	1.5	.11L	1.7	3.1	6.2	20	3	N	.16	D201442
D201444	100	1.5	.04L	3.6	1.7	4.1	20L	1.5	1.5	.06	D201444
D201445	100	2	.12L	9.4	2.8	6.3	20L	2	3	.01	D201445
D201446	100	N	.09L	.9	.2	1.8L	20L	N	N	.02	D201446
D201447	700	N	.12L	1.4	8.0	19	75	7	N	.06	D201447
D201448	500	N	.11L	.1L	.1L	16	60	7	N	.03	D201448
D201449	500	N	.11L	1.7	8.0	18	60	5	N	.07	D201449
D201450	500	N	.09L	2.4	3.3	9.8	55	2	N	.04	D201450
D201451	500	.2	.08L	2.5	3.9	11	45	2	N	.05	D201451
D205218	300	1.5	.52L	7.4	38	48	280	20	N	.12	D205218
D205219	1,000	.5	.13L	1.2	3.7	16	95	5	N	.03	D205219
D205220	700	1	.10L	2.4	8.4	22	80	5	N	.05	D205220
D205221	150	2	.11L	5.5	5.9	17	40	7	N	.03	D205221
D205222	150	2	.10L	6.9	1.8	7.4	40	5	N	.02	D205222
D205223	200	.7	.22L	2.3	4.0	18	45	7	N	.03	D205223
D205224	150	1	.11L	3.7	1.8	8.1	45	5	N	.03	D205224
D205225	150	1.5	.09L	5.2	3.5	9.1	30	5	N	.05	D205225
D205226	200	1.5	.18L	4.2	4.4	28	60	15	N	.04	D205226
D205227	200	1.5	.18L	3.3	6.5	19	110	15	N	.06	D205227
D205228	300	1	.15L	3.2	6.0	10	210	7	N	.07	D205228
D205230	1,000	2	.32	7.4	37	52	240	20	N	.42	D205230
D205231	700	2	.34L	6.0	38	68	190	15	N	.09	D205231
D205232	200	1	.17L	2.9	11	29	55	5	N	.09	D205232

Table D4. Major-, minor- and trace-element composition of 33 coal and coal-associated rock samples from the Raton Mesa Region, Colorado (cont.).

Sample number	La-S (ppm)	Li (ppm)	Mn (ppm)	Mo-S (ppm)	Nb-S (ppm)	Nd-S (ppm)	Ni-S (ppm)	P (ppm)	Pb (ppm)	Sb (ppm)	Sample number
D180089	30	32	27	5	10	50	10	1,300L	12	0.5	D180089
D180090	70L	41	57	5	10	N	10	2,500L	20	.7	D180090
D180091	30L	29	62	5	5	N	7	1,500	8.3	.7	D180091
D180092	30L	24	450	2	7	N	10	1,700	7.6L	.4	D180092
D188241	N	13	150	N	15	N	10	3,900L	22L	1.0	D188241
D188242	N	21	150	N	N	N	5	3,900L	23L	.6	D188242
D184634	15L	5.8	17	1	7	20L	7	560L	12	.2	D184634
D184635	15	11	85	1	5	N	5	630L	7.2	.3	D184635
D201440	7L	2.2	51	.7	N	N	7	44L	2.2	.1	D201440
D201441	7L	1.3	130	.5L	N	N	2	43L	1.6L	.1L	D201441
D201442	N	4.1	52	.7	N	B	3	42L	2.7L	.1	D201442
D201444	5L	1.4	13	.3	N	N	5	43L	1.1L	.1	D201444
D201445	N	3.7	35	N	N	B	3	45L	2.9L	.3	D201445
D201446	N	1.3	56	N	N	B	N	44L	2.3L	.1L	D201446
D201447	10L	13	15	1.5	2	N	3	1,400	2.9L	.3	D201447
D201448	10L	12	10	1.5	3	N	5	1,100	3.3	.1L	D201448
D201449	10L	13	9.1	1.5	3	N	7	1,200	2.8L	.2	D201449
D201450	10L	5.0	14	1.5	1.5	N	7	870	2.2	.1	D201450
D201451	7L	4.9	13	1	1.5	N	7	740	1.9L	.1	D201451
D205218	50L	41	37	3	15	N	15	90	19	.7	D205218
D205219	15L	6.4	51	1	5	N	2	2,200	3.2L	.2	D205219
D205220	10L	6.0	21	.7	5	N	3	1,600	3.7	.2	D205220
D205221	15	10	15	3	7	15	10	44	7.2	.4	D205221
D205222	15	15	16	2	5	15	7	43L	3.2	.2	D205222
D205223	N	34	34	N	7	B	2L	47L	13	.3	D205223
D205224	10L	7.0	7.8	1	7	N	3	43L	5.4	.2	D205224
D205225	15	11	7.7	2	2	15	10	45	4.3	.4	D205225
D205226	N	17	28	3	10	B	5	130	9.4	.3	D205226
D205227	30	39	11	3	15	30	5	520	11	.4	D205227
D205228	15L	20	12	2	10	N	5	1,300	9.1	.3	D205228
D205230	50	33	25	5	15	50	20	1,700	17	.8	D205230
D205231	50	35	55	3	15	50	15	1,100	14	.7	D205231
D205232	15	14	120	2	5	N	10	44L	5.6	.3	D205232

Table D4. Major-, minor- and trace-element composition of 33 coal and coal-associated rock samples from the Raton Mesa Region, Colorado (cont.).

Sample number	Sc-S (ppm)	Se (ppm)	Sr-S (ppm)	Th (ppm)	U (ppm)	V-S (ppm)	Y-S (ppm)	Yb-S (ppm)	Zn (ppm)	Zr-S (ppm)	Sample number
D180089	7	2.4	300	7.7	3.5	100	20	2	25	50	D180089
D180090	10	2.4	300	13.4	4.6	150	15	5	64	70	D180090
D180091	5	3.0	200	4.6	2.5	70	15	2	22	20	D180091
D180092	5	2.5	200	6.8	2.3	50	15	2	21	50	D180092
D188241	15	.6	700	7.0	4.0	70	30	3	88	300	D188241
D188242	7	.3	500	3.9	2.3	30	10	2	33	200	D188242
D184634	2	1.9	100	5.3	2.2	10	10	1	12	20	D184634
D184635	2	B	70	4.6	1.7	10	10	1	6.9	30	D184635
D201440	1	1.3	100	.9	.4	10	15	1	4.1	7	D201440
D201441	.7	.9	150	.4	.2	5	10	.7	1.3L	7	D201441
D201442	1.5	1.3	200	1.0	.5	15	15	1.5	4.8	10	D201442
D201444	.7	1.1	100	.5	.4	7	15	1	2.2	5	D201444
D201445	1.5	1.1	100	1.3	.5	7	15	1	2.6	15	D201445
D201446	N	.3	100	.1L	.2L	N	2	.2L	1.8L	N	D201446
D201447	3	2.6	300	3.3	1.3	20	7	.7	3.0	15	D201447
D201448	3	.1L	300	.1L	1.1	20	5	.5	3.2	15	D201448
D201449	3	2.5	200	3.5	1.4	20	5	.5	2.4	15	D201449
D201450	1.5	3.0	200	2.0	.6	15	5	.5	2.2	15	D201450
D201451	1	3.4	200	2.2	.7	10	5	.5	2.0	10	D201451
D205218	15	4.1	100	11.0	4.4	100	30	3	32	100	D205218
D205219	2	1.9	1,000	3.3	1.3	20	10	.7	3.9	20	D205219
D205220	5	2.7	300	4.2	1.6	20	5	.7	1.0	20	D205220
D205221	7	4.9	70	3.1	1.1	20	30	2	19	30	D205221
D205222	3	1.5	50	1.9	.6	20	20	1.5	4.3	30	D205222
D205223	3	3.9	50	5.1	1.9	20	15	1.5	9.5	100	D205223
D205224	3	2.7	50	3.4	.9	20	7	.7	1.7	30	D205224
D205225	2	2.6	50	2.0	.7	15	15	1.5	1.0	15	D205225
D205226	5	4.3	50	4.7	1.7	30	15	1.5	17	50	D205226
D205227	5	4.2	200	5.7	1.9	50	20	2	13	50	D205227
D205228	5	4.3	300	6.0	2.0	30	10	1	8.1	50	D205228
D205230	15	2.5	700	10.0	5.3	100	50	5	42	50	D205230
D205231	10	2.7	300	9.9	4.4	70	30	2	41	50	D205231
D205232	5	2.4	150	4.8	2.1	20	15	1	17	30	D205232

Table D5. Arithmetic mean, observed range, geometric mean, and geometric deviation of proximate and ultimate analyses, heat of combustion, forms of sulfur, and ash-fusion temperatures of 31 coal samples from the Raton Mesa and Canon City Regions, Colorado.

[All values are in percent except Kcal/kg, Btu/lb, ash-fusion temperatures, and geometric deviation and are reported on the as-received basis. °F = (C° x 1.8) + 32; Kcal/kg = 0.556 (Btu/lb)]

	Arithmetic mean	Observed range		Geometric mean	Geometric deviation
		Minimum	Maximum		
Proximate and ultimate analyses					
Moisture	3.9	0.9	10.5	3.0	2.0
Volatile matter	33.5	17.2	40.6	32.7	1.2
Fixed carbon	46.6	23.2	54.7	45.7	1.2
Ash	16.1	4.2	53.3	13.4	1.8
Hydrogen	5.1	2.8	5.9	5.0	1.2
Carbon	65.1	33.3	77.4	63.9	1.2
Nitrogen	1.3	.7	1.7	1.3	1.3
Oxygen	11.7	5.5	22.9	10.7	1.5
Sulfur	.7	.4	1.9	.6	1.5
Heat of combustion					
Kcal/kg	6,425	3,775	7,710	6,305	1.2
Btu/lb	11,560	5,890	13,870	11,340	1.2
Forms of sulfur					
Sulfate	0.01	0.01	0.09	0.01	1.5
Pyritic	.16	.04	.68	.13	2.0
Organic	.52	.28	1.41	.49	1.4
Ash-fusion temperatures, °C					
Initial deformation	1,365	1,095	1,355	1,355	1.1
Softening temperature	1,410	1,155	1,600	1,400	1.1
Fluid temperature	1,455	1,210	1,600	1,450	1.1

Table D6. Arithmetic mean, observed range, geometric mean, and geometric deviation of ash content and contents of ten major and minor oxides in the laboratory ash of 31 coal samples from the Raton Mesa and Canon City Regions, Colorado.

[All samples were ashed at 525°C; all analyses except geometric deviation are in percent; L, less than the value shown]

Oxide	Arithmetic mean	Observed range		Geometric mean	Geometric deviation
		Minimum	Maximum		
(Ash)	21.0	4.3	90	16.1	2.1
SiO_2	48	26	73	45	1.4
Al_2O_3	22	1.9	34	20	1.7
CaO	11	.42	31	6.3	2.8
MgO	1.3	.17	3.5	1.0	2.0
Na_2O	.68	.04	2.2	.43	2.6
K_2O	.51	.02L	1.9	.23	3.7
Fe_2O_3	6.1	2.1	14	5.5	1.6
TiO_2	1.4	.05L	3.2	1.2	1.6
SO_3	4.5	.25	17	2.4	3.1

Table D7. Arithmetic mean, observed range, geometric mean, and geometric deviation of 37 elements in 31 coal samples from the Raton Mesa and Canon City Region, Colorado.

[All analyses are in percent or parts per million and are reported on a whole-coal basis. As, F, Hg, Sb, Se, Th, and U values used to calculate the statistics were determined directly on whole coal. All other values used were calculated from determinations made on coal ash. L, less than the value shown]

Element	Arithmetic mean	Observed range		Geometric mean	Geometric deviation
		Minimum	Maximum		
		Percent			
Si	5.2	0.78	30	3.4	2.5
Al	2.7	.091	8.1	1.7	2.7
Ca	1.1	.15	2.7	.73	2.4
Mg	.16	.009	.44	.099	2.6
Na	.11	.005	1.5	.051	3.5
K	.20	.001L	1.4	.029	7.5
Fe	.74	.30	3	.62	1.8
Ti	.17	.003L	.43	.12	2.4
		Parts per million			
As	1.3	0.3	5.5	1.0	2.1
B	20	15L	70	20	1.5
Ba	500	100	1500	300	2.3
Be	1.5	.2	3	.7	3.0
Cd	.19	.04L	.32	.14	2.1
Cu	21	1.8L	68	14	2.4
F	130	20L	1400	67	3.2
Ga	10	1	30	5	2.6
Ge	2	1.5	3	2	1.5
Hg	.09	.01	.42	.06	2.2
La	10	5L	50	10	2.3
Li	18	1.3	41	11	2.8
Mn	52	7.7	450	32	2.7
Mo	2	.3	5	1	3.0
Nb	7	1.5	15	5	2.8
Ni	7	2L	20	5	1.9
P	1800	42L	2200	62	16.0
Pb	6.9	1.1L	20	3.6	3.2
Sb	.3	.1L	1	.2	2.0
Sc	5	.7	15	3	2.5
Se	2.6	.1L	4.9	1.9	2.2
Sr	200	50	1000	100	2.3
Th	5	.1L	13.4	3	2.8
U	2	.15	5.3	1.3	2.6
V	30	5	150	20	2.5
Y	15	2	50	10	2.0
Yb	1.5	.2L	5	1	1.9
Zn	18	1.0	88	6.9	4.0
Zr	50	5	300	30	2.7

Table D8. Proximate and ultimate analyses, forms of sulfur, and heat value determinations of 18 coal samples from the Raton Mesa region.

[All analyses except heat-of-combustion are in percent. Basis represent the form of analyses: 1, as received; 2, moisture free; 3, moisture and ash free.]

Sample #	Lab #	Basis	Moisture	Volatile-Matter	Fixed Carbon	Ash	H	C	N	O	S	Sulfur Forms			Heat Value	
												Sulfate	Pyritic	Organic	Btu/lb	Kcal/Kg
TRINIDAD FIELD																
CFI 29-1																
Run 1	K89037	1	0.9	35.0	52.8	11.3	5.4	74.2	1.5	6.9	0.7	0.01	0.12	0.53	13332	7407
		2		35.3	53.3	11.4	5.4	74.9	1.6	6.1	0.7	0.01	0.12	0.53	13456	7476
		3		39.9	60.1		6.0	84.5	1.8	6.9	0.8	0.01	0.14	0.60	15186	8437
Run 2 Upper	K89038	1	0.9	28.2	50.2	20.7	4.8	65.1	1.1	7.5	0.7	0.01	0.12	0.59	11598	6443
		2		28.5	50.6	20.9	4.8	65.7	1.2	6.7	0.7	0.01	0.12	0.60	11707	6504
		3		36.0	64.0		6.0	83.1	1.5	8.5	0.9	0.01	0.15	0.75	14803	8224
Run 2 Lower	K89039	1	0.9	30.5	53.0	15.6	5.0	70.5	1.3	6.9	0.7	0.01	0.10	0.58	12623	7013
		2		30.8	53.5	15.7	4.9	71.1	1.3	6.2	0.7	0.01	0.10	0.59	12738	7077
		3		36.5	63.5		5.9	84.4	1.6	7.3	0.8	0.01	0.12	0.69	15112	8376
Run 3	K90194	1	1.0	34.3	52.5	12.2	5.1	72.8	1.3	7.9	0.7	0.01	0.16	0.53	13259	7366
		2		34.7	53.0	12.3	5.0	73.5	1.3	7.1	0.7	0.01	0.16	0.54	13392	7440
		3		39.5	60.5		5.7	83.9	1.5	8.1	0.8	0.01	0.18	0.61	15277	8487
Run 4	K90195	1	1.0	31.1	51.0	16.9	4.9	69.1	1.2	6.9	1.0	0.01	0.40	0.58	12344	6858
		2		31.4	51.5	17.1	4.9	69.8	1.2	6.1	1.0	0.01	0.40	0.59	12471	6928
		3		37.9	62.1		5.9	84.2	1.4	7.3	1.2	0.01	0.49	0.71	15039	8355
Run 5	K89074	1	2.0	28.5	38.5	31.0	4.4	56.5	1.1	6.1	0.9	0.01	0.50	0.35	10108	5616
		2		29.1	39.2	31.7	4.3	57.6	1.1	4.4	0.9	0.01	0.51	0.36	10317	5732
		3		42.6	57.4		6.3	84.3	1.6	6.4	1.3	0.01	0.75	0.52	15096	8387
CFI 29-2																
Run 1 Upper	K88878	1	1.7	18.6	24.1	55.6	3.1	33.9	0.7	6.3	0.4	0.01	0.17	0.24	6177	3432
		2		18.9	24.5	56.6	2.9	34.5	0.7	4.8	0.4	0.01	0.17	0.24	6286	3492
		3		43.6	56.4		6.7	79.5	1.5	11.2	1.5	0.02	0.40	0.56	14480	8044
Run 1 Lower	K89372	1	1.0	26.0	30.5	42.5	3.9	45.9	0.9	6.2	0.5				8352	4740
		2		26.3	30.8	42.9	3.8	46.4	1.0	5.4	0.5				8435	4686
		3		46.1	53.9		6.7	81.3	1.7	9.4	0.9				14780	8211
Run 3 Upper	K88879	1	1.0	29.5	51.2	18.3	4.7	67.4	1.2	7.6	0.7	0.01	0.11	0.61	12076	6709
		2		29.8	51.7	18.5	4.7	68.1	1.2	6.8	0.7	0.01	0.11	0.62	12193	6774
		3		36.5	63.5		5.8	83.5	1.5	8.4	0.9	0.01	0.14	0.76	14560	8311
Run 3 Lower	K89024	1	0.8	29.3	49.0	20.8	4.6	65.2	1.2	7.4	0.7	0.01	0.14	0.58	11710	6506
		2		29.6	49.4	21.0	4.6	65.8	1.2	6.7	0.7	0.01	0.14	0.58	11809	6561
		3		37.5	62.5		5.8	83.3	1.5	8.5	0.9	0.01	0.18	0.74	14942	8301
Run 4 Upper	K89025	1	0.7	35.8	50.6	12.9	5.2	72.0	1.5	7.7	0.6	0.01	0.10	0.47	13118	7288
		2		36.0	51.0	13.0	5.2	72.6	1.5	7.1	0.6	0.01	0.10	0.47	13212	7340
		3		41.4	58.6		6.0	83.4	1.7	8.2	0.7	0.01	0.12	0.54	15190	8439

Table D8 (cont.).

Sample #	Lab #	Basis	Moisture	Volatile-Matter	Fixed Carbon	Ash	H	C	N	O	S	Sulfur Forms			Heat Value	
												Sulfate	Pyritic	Organic	Btu/lb	Kcal/Kg
Run 4 Lower	K89042	1	1.2	29.8	56.7	12.3	5.2	73.2	1.4	7.2	0.7	0.01	0.10	0.57	13067	7259
		2		30.2	57.3	12.5	5.2	74.1	1.4	6.2	0.7	0.01	0.10	0.58	13220	7344
		3		34.5	65.5		5.9	84.6	1.6	7.1	0.8	0.01	0.12	0.66	15108	8393
Run 5	K89026	1	0.7	29.0	53.0	17.3	4.8	69.6	1.2	6.2	0.9	0.01	0.17	0.68	12338	6854
		2		29.2	53.4	17.4	4.7	70.1	1.2	5.6	0.9	0.01	0.17	0.68	12421	6901
		3		35.4	64.6		5.7	84.9	1.5	6.8	1.0	0.01	0.21	0.83	15043	8357
Run 6	K89027	1	0.7	30.7	47.3	21.3	4.8	65.0	1.2	6.9	0.8	0.01	0.21	0.57	11737	6521
		2		30.9	47.7	21.4	4.8	65.5	1.2	6.3	0.8	0.01	0.21	0.57	11824	6569
		3		39.4	60.6		6.1	83.4	1.6	8.0	1.0	0.01	0.27	0.73	15049	8361
USGS 78-2A																
Run 4	K86616	1	1.1	21.6	42.1	35.2	3.8	53.4	1.1	6.0	0.5				9595	5331
		2		21.9	42.5	35.6	3.7	54.0	1.1	5.1	0.5				9704	5391
		3		33.9	66.1		5.8	83.9	1.7	7.9	0.7				15065	8369
Run 6	K86617	1	0.8	22.7	40.6	35.9	3.8	53.2	1.1	5.6	0.4				9416	5231
		2		22.9	41.0	36.1	3.8	53.6	1.1	5.0	0.4				9489	5272
		3		35.9	64.1		5.9	83.9	1.8	7.8	0.6				14857	8254
USGS 78-4A																
Run 2	K86618	1	0.8	18.7	41.5	39.0	3.3	52.0	0.8	4.6	0.3				9056	5031
		2		18.9	41.8	39.3	3.3	52.4	0.8	3.9	0.3				9133	5074
		3		31.1	68.9		5.4	86.4	1.4	6.4	0.5				15057	8365
Run 3	K86619	1	0.9	21.9	47.6	29.6	3.8	58.7	1.0	4.4	2.5				10507	5834
		2		22.1	48.0	29.9	3.7	59.2	1.0	3.6	2.5				10601	5889
		3		31.5	68.5		5.3	84.5	1.5	5.2	3.5				15120	8400

Section E
Chemical Analyses of Coal Samples from the
San Juan River Region

Figure E1. The B coal seam at the Martinez strip mine in the San Juan River Region.

San Juan River Region

The Colorado portion of the San Juan River region is a roughly "L"-shaped area in the southwest corner of the state (see figure E2). It stretches from near Pagosa Springs west to the Four Corners,and from the Colorado-New Mexico border north to Grand Junction. The south dipping, synclinal structure of the region is primarily controlled by the greater San Juan Basin itself, which extends almost 200 miles south into New Mexico. Parts of the San Juan River region fall into 13 counties in Colorado. Four of these counties which have current coal production are: Archuleta, La Plata, Montrose, and San Miguel; while the remaining nine counties are: Delores, Delta, Gunnison, Hinsdale, Mesa, Mineral, Montezuma, Ouray, and San Juan. The region is geographically characterized by disected plateaus with low to medium relief and several young to mature fluvial systems. Coal beds occur in the Dakota, Menefee, and Fruitland Formations of Cretaceous age (see figures E3, E4 and E5. The outline of the region is determined by the outcrop and/or the subsurface coal bearing extent of the Dakota Formation. The younger Menefee and Fruitland Formations are almost entirely restricted to the area south of township of 38 N. These two formations are nearly absent in the northern portion of the region where all coal beds are found in the Dakota Formation.

Chemical analyses of 12 coal samples from this region have been completed and sample locations are shown in figure E1. Ten of these samples were collected from three mines while the other two are from two drill holes. Because of the sparcity of data, the statistical data at the end of this section should be considered a summary of these analyses only, and should not be construed as to be representative of the entire basin. Generally the sulfur values are fairly consistant in the samples (0.7 to 0.9%); however, the ash values vary from 5.4% to 27.1%. Nine of the coal samples ranked high-volatile A bituminous coal while the other three samples are high-volatile B bituminous coal.

All three of the established and producing coal fields in the San Juan River region, the Durango, Pagosa Springs, and Nucla Naturita fields were sampled for the report. There are 194 mines of record in the San Juan River region which have produced over 12 million tons of coal. In 1979 total production for the region was almost 300,000 tons from 7 mines. According to Boreck and Murray (1979), the remaining demonstrated coal reserve base is over 1.3 billion tons.

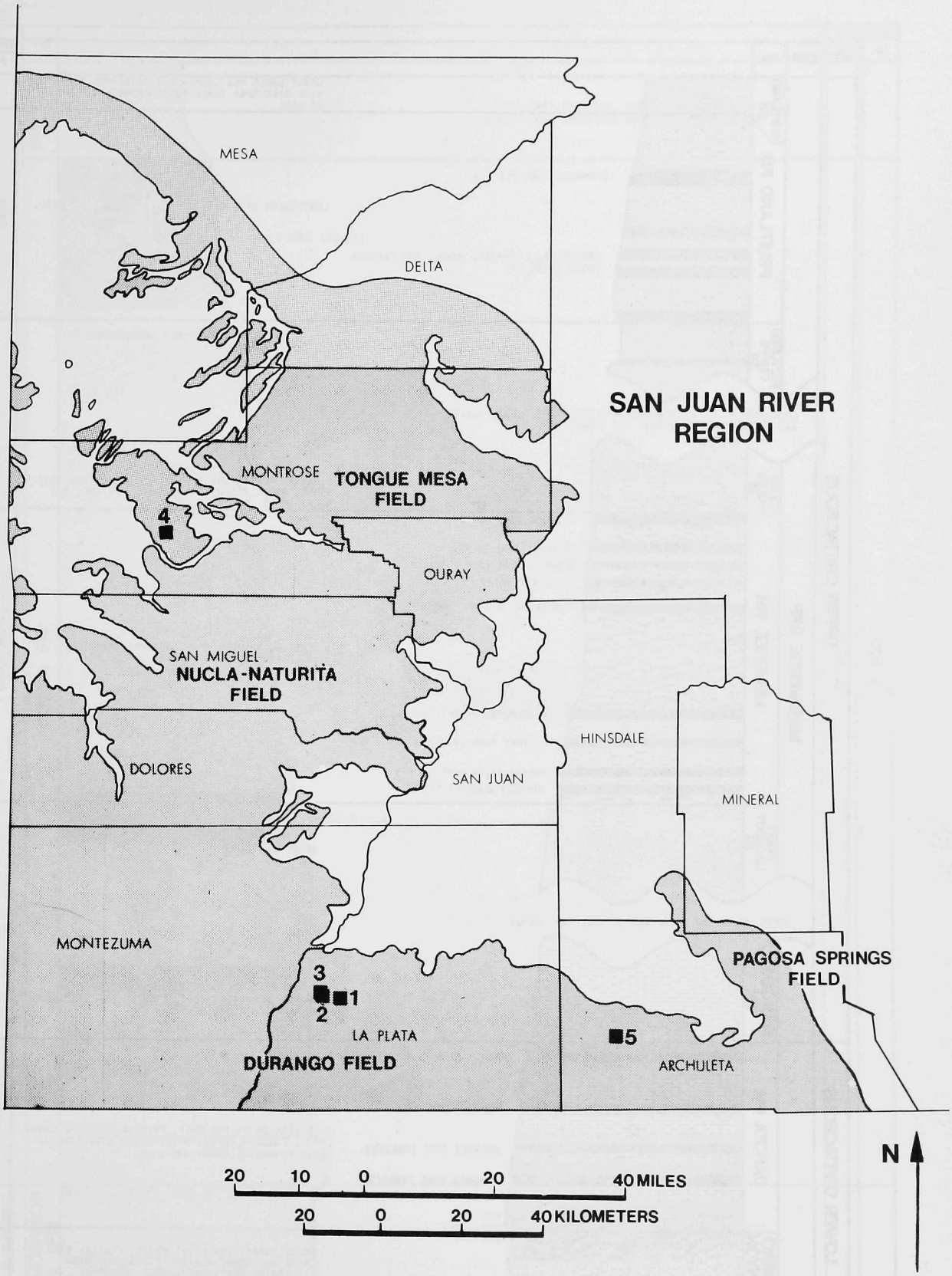


Figure E2. Location of samples within the San Juan River Region.

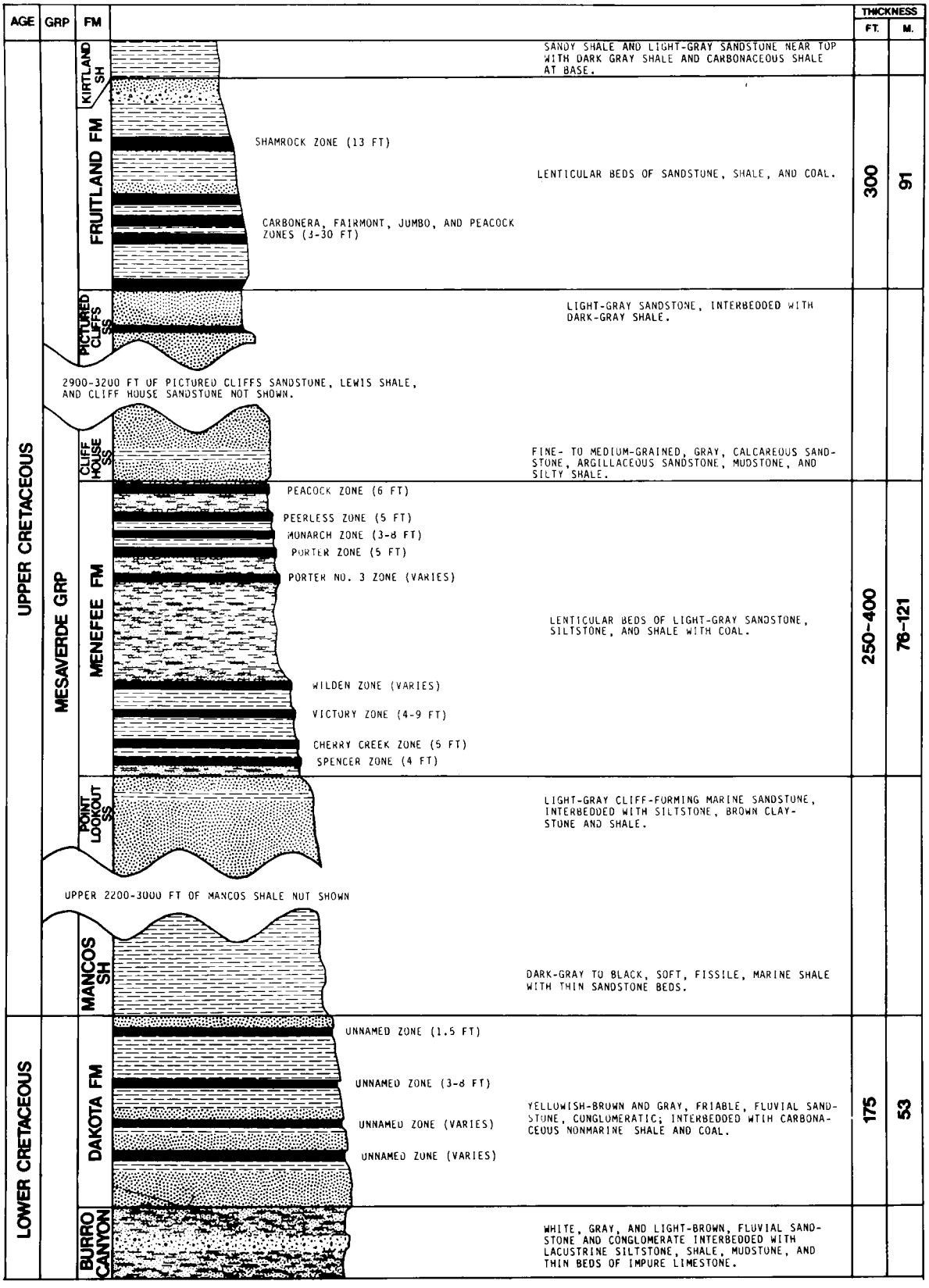


Figure E3. Generalized stratigraphic section of coal bearing rocks in the San Juan River Region, Durango field. Coal zones shown in black (after Boreck and Murray, 1979; Haynes and others, 1972).

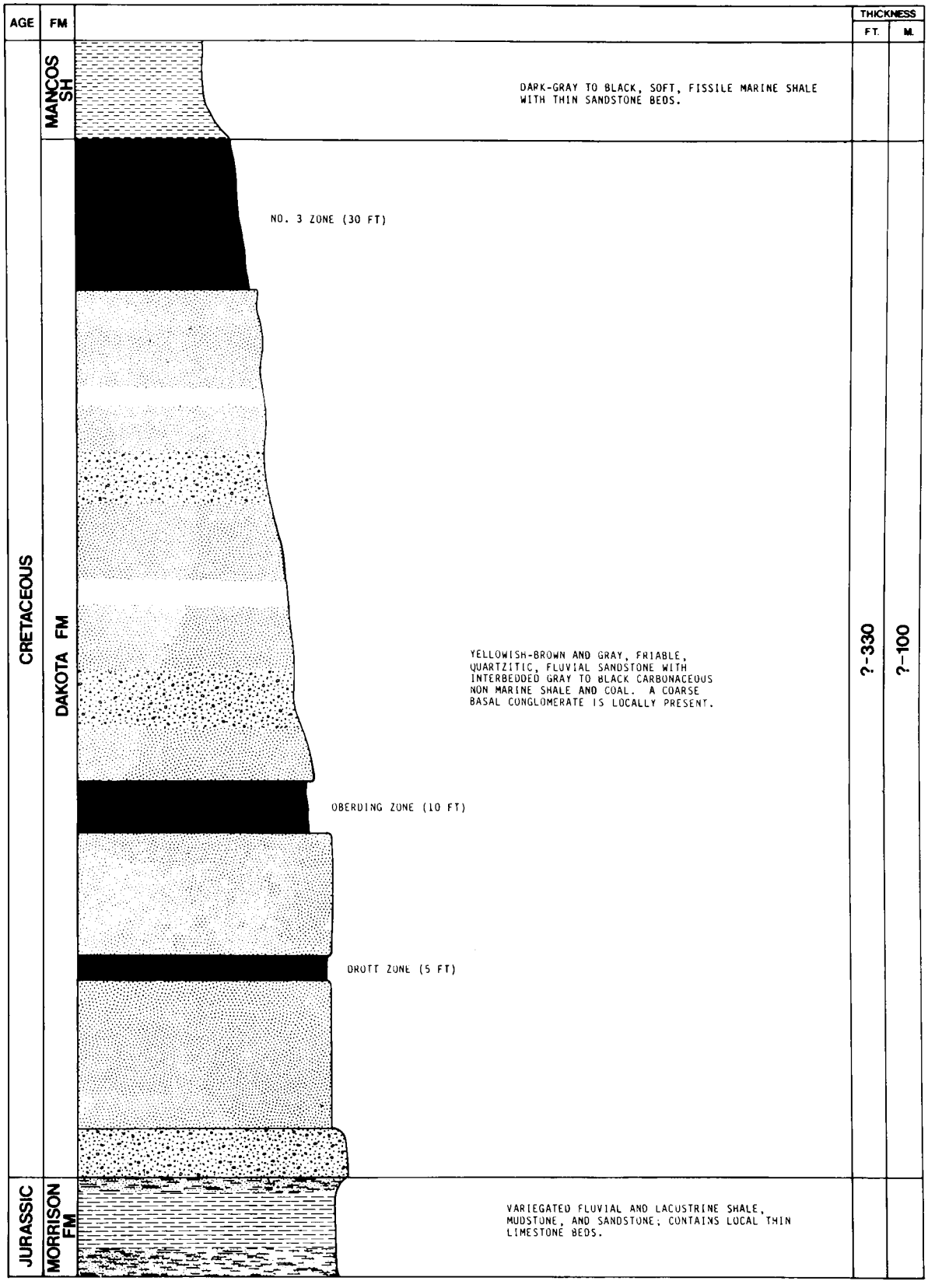


Figure E4. Generalized stratigraphic section of coal-bearing rocks in the San Juan River Region, Nucla/Naturita field. Coal zones shown in black (after Boreck and Murray, 1978; Hornbaker and others, 1976; Williams, 1964).

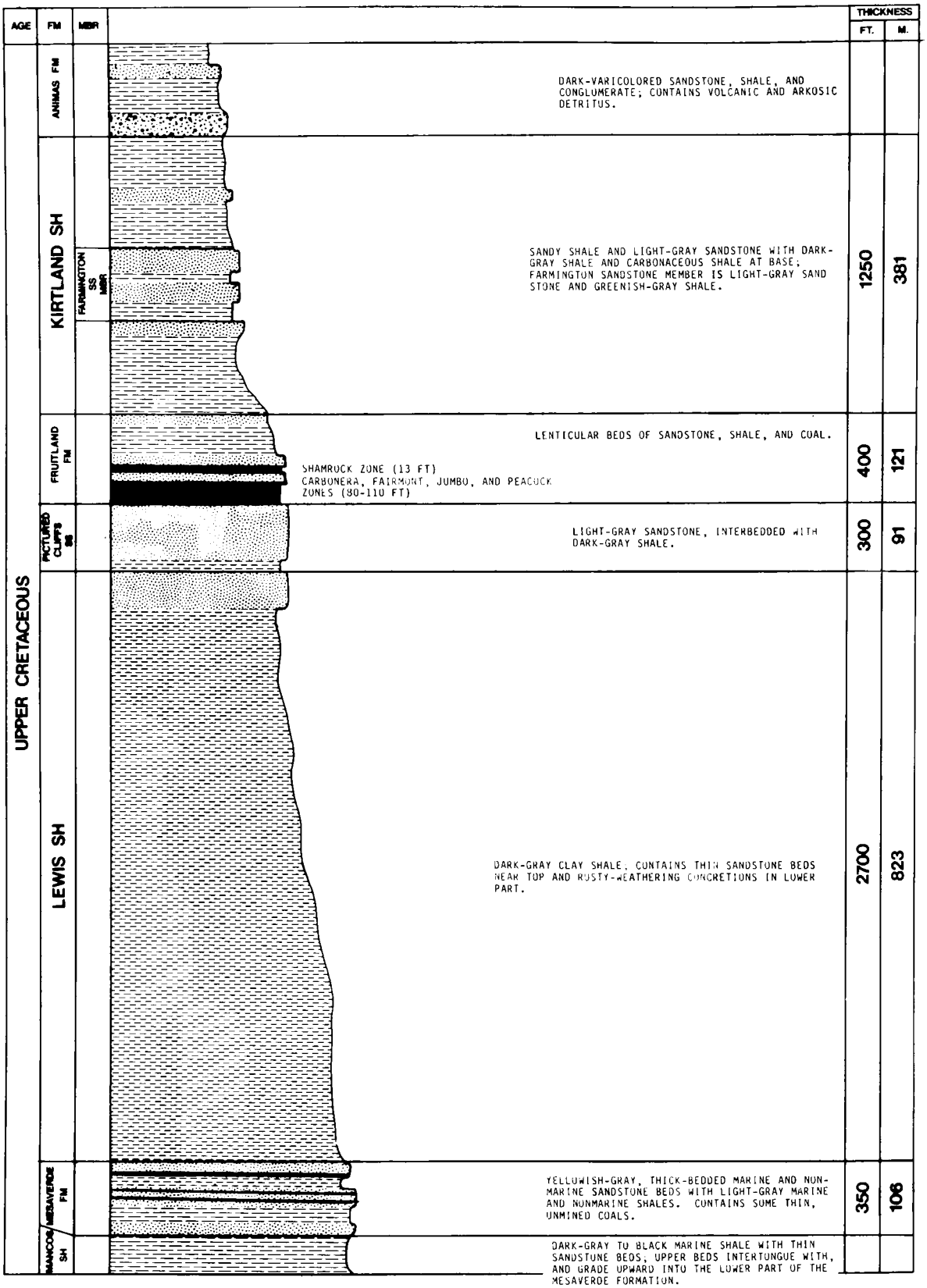


Figure E5. Generalized stratigraphic section of coal-bearing rocks in the San Juan River Region, Pagosa Springs field. Coal zones shown in black (after Boreck and Murray, 1979; Steven and others, 1974).

MAP INDEX #	FIELD/AREA	COUNTY	LOCATION SEC.	TWP.	RGE.	CGS SAMPLE #	USGS SAMPLE #	US DOE SAMPLE #	SAMPLE TYPE
1	Durango	La Plata	31	35N	11W	78-CGS-4	D205240	K88641	Core
			26	35N	12W	76-H-1	D180093	K68967	Core
			36	35N	12W	76-H-2	D180094	K68968	Core
2	Nucla/	Montrose	36	47N	16W	78-CGS-2	D205241	K88642	Channel
3	Naturita					78-CGS-3	D205242	K88643	Channel
4	Pagosa	Archuleta	30	33 1/2N	4W	78-CGS-5	D205237	K88638	Channel
5	Springs					78-CGS-6	D205238	K88639	Channel
						78-CGS-8	D205239	K88640	Channel
						78-CGS-9	D205234	K88635	Channel
						78-CGS-11	D205235	K88636	Channel
						78-CGS-13	D205236	K88637	Channel
						78-CGS-14	D205233	K88634	Channel

Figure E6. Sample index for the San Juan River Region. (Map index number refers to figure E2.)

SAN JUAN RIVER REGION
DURANGO FIELD

LA PLATA COUNTY

SAMPLE NUMBER: 78-CGS-4

COAL BED NAME: Pueblo

GEOLOGIC ROCK UNIT: Menefee Fm

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: 6 Meters: 1.8

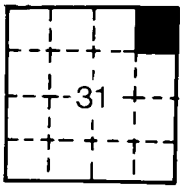
OVERBURDEN AT SAMPLING POINT:
Feet: 500 Meters: 152

STRIKE: N 80°E

DIP: 10°SE

MAJOR CLEAT ORIENTATION IN COAL:
Face: N-S
Butt: N 85°W

LOCATION IN SECTION



SECTION: 31

TOWNSHIP: 35 N

RANGE: 11 W

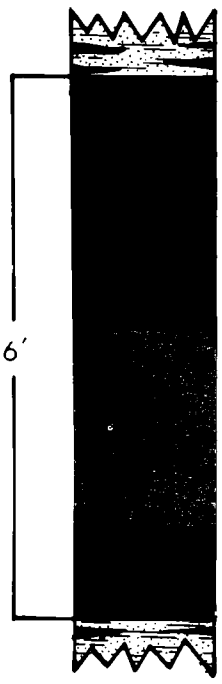
USGS TOPOGRAPHIC QUADRANGLE:
Hesperus 7.5' (1963)

MINE NAME: Blue Flame

MINE TYPE: Underground

OPERATOR/OWNER: Fidel Lobato

PUEBLO COAL BED



INTERBEDDED SANDSTONE, SHALE AND COAL; white, medium-grained sandstone, dark shale and vitrain stringers.

COAL: Sample No. 78-CGS-4, hard, thin vitrain bands in dull attritus.

INTERBEDDED SANDSTONE, SHALE, AND COAL: as above.

ANALYSES LABORATORY NUMBERS
USBM/DOE: K88641
USGS: D205240

APPARENT RANK OF COAL:
High-volatile B bituminous

THICKNESS OF COAL:
Feet: 6 Meters: 1.8

THICKNESS SAMPLED:
Feet: 6 Meters: 1.8

TYPE OF SAMPLE: Coal-channel

DURANGO FIELD

LA PLATA COUNTY

SAMPLE NUMBER: 76-H-1

COAL BED NAME: Unnamed

GEOLOGIC ROCK UNIT: Menefee Fm

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: -- Meters: --

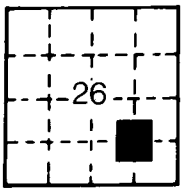
OVERBURDEN AT SAMPLING POINT:
Feet: 295 Meters: 90

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 26

TOWNSHIP: 35 N

RANGE: 12 W

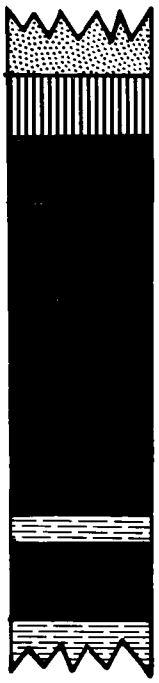
USGS TOPOGRAPHIC QUADRANGLE:
Thompson Park 7.5' (1963)

DRILL HOLE: C-26-1

MINE TYPE: --

OPERATOR/OWNER: Calder & Co.

COAL BED NAME UNKNOWN



SANDSTONE: silty to very fine grained.

COAL: Sample No. 76-H-1, top to bottom as follows: shaly coal, coal, silty shale parting, shaly coal (thickness confidential).

SHALE: light gray.

SHALE: light gray.

ANALYSES LABORATORY NUMBERS
USBM/DOE: K68967
USGS: D180093

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: -- Meters: --

THICKNESS SAMPLED:
Feet: -- Meters: --

TYPE OF SAMPLE: Drill Core: Coal

SAN JUAN RIVER REGION
DURANGO FIELD

LA PLATA COUNTY

SAMPLE NUMBER: 76-H-2

COAL BED NAME: Unnamed

GEOLOGIC ROCK UNIT: Menefee Fm

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: -- Meters: --

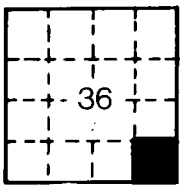
OVERBURDEN AT SAMPLING POINT:
Feet: 315 Meters: 96

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 36

TOWNSHIP: 35 N

RANGE: 12 W

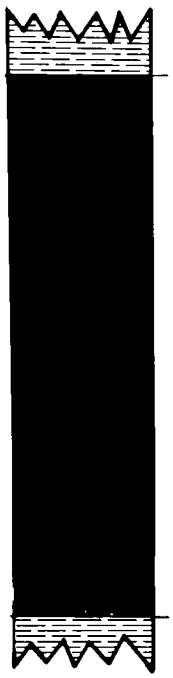
USGS TOPOGRAPHIC QUADRANGLE:
Kline 7.5' (1968)

DRILL HOLE: C-36-1

MINE TYPE: --

OPERATOR/OWNER: Calder & Co.

COAL BED NAME UNKNOWN



SHALE

COAL: Sample No. 76-H-2, banded, vitrain in dull to moderate attritus (thickness confidential).

CARBONACEOUS SHALE

ANALYSES LABORATORY NUMBERS
USBM/DOE: K68968
USGS: D180094

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: -- Meters: --

THICKNESS SAMPLED:
Feet: -- Meters: --

TYPE OF SAMPLE: Drill Core: Coal

SAN JUAN RIVER REGION
NUCLA/NATURITA FIELD

MONTROSE COUNTY

SAMPLE NUMBER: 78-CGS-2,3

COAL BED NAME: Unnamed

GEOLOGIC ROCK UNIT: Dakota

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 7.6 Meters: 2.3

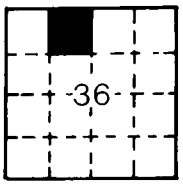
OVERBURDEN AT SAMPLING POINT:
Feet: 25 Meters: 8

STRIKE: N 65°E

DIP: 4°NW

MAJOR CLEAT ORIENTATION IN COAL:
Face: N 63°E
Butt: N 52°W

LOCATION IN SECTION



SECTION: 36

TOWNSHIP: 47 N

RANGE: 16 W

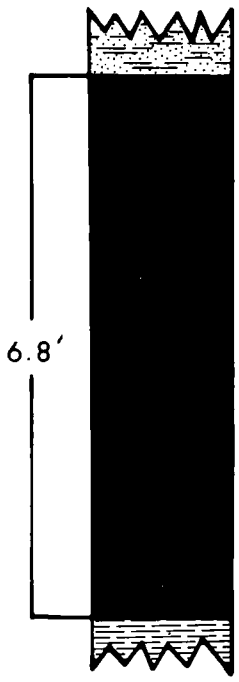
USGS TOPOGRAPHIC QUADRANGLE:
Nucla 7.5' (1960)

MINE NAME: Nucla Strip

MINE TYPE: Surface

OPERATOR/OWNER: Peabody Coal Co.

COAL BED NAME UNKNOWN



0.8' COAL: Sample No. 78-CGS-2.

6.0' COAL: Sample No. 78-CGS-3, banded, vitrain in attritus, gypsum present, some pyrite in fractures.

CARBONACEOUS SHALE: dark gray.

SAMPLE NUMBER: 78-CGS-2

ANALYSES LABORATORY NUMBERS
USBM/DOE: K88642
USGS: D205241

APPARENT RANK OF COAL:
High-volatile B bituminous

THICKNESS OF COAL:
Feet: 0.8 Meters: 0.2

THICKNESS SAMPLED:
Feet: 0.8 Meters: 0.2

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: 78-CGS-3

ANALYSES LABORATORY NUMBERS
USBS/DOE: K88643
USGS: D205242

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 6.0 Meters: 1.8

THICKNESS SAMPLED:
Feet: 6.0 Meters: 1.8

TYPE OF SAMPLE: Coal-channel

SAN JUAN RIVER REGION
PAGOSA SPRINGS FIELD

ARCHULETA COUNTY

SAMPLE NUMBERS: 78-CGS-5,6,8

COAL BED NAME: "C"

GEOLOGIC ROCK UNIT: Upper Fruitland

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: 7.6 Meters: 2.3

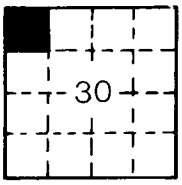
OVERBURDEN AT SAMPLING POINT:
Feet: 15 Meters: 4.2

STRIKE: N 50°W

DIP: 12°NE

MAJOR CLEAT ORIENTATION IN COAL:
Face: N 30°W
Butt: N 60°E

LOCATION IN SECTION



SECTION: 30

TOWNSHIP: 33 1/2 N

RANGE: 4 W

USGS TOPOGRAPHIC QUADRANGLE:
Chimney Rock 7.5' (1968)

MINE NAME: Martinez Strip

MINE TYPE: Surface

OPERATOR/OWNER: Chimney Rock Coal Co.

"C" COAL BED

SHALE: gray, hard, blocky, fossiliferous.

1.5' COAL: Sample No. 78-CGS-5, dominant thick vitrain bands in moderately dull attritus, well developed cleat.

3.5' COAL: Sample No. 78-CGS-6, abundant vitrain bands in dull attritus.

0.7' SHALE: reddish hematitic clay.

1.9' COAL: Sample No. 78-CGS-8, as above, trace disseminated pyrite, gradational basal contact.

CARBONACEOUS SHALE: brown, few lenses of reddish clay.

SAMPLE NUMBER: 78-CGS-5

ANALYSES LABORATORY NUMBERS
USBM/DOE: K88638
USGS: D205237

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 1.5 Meters: 0.4

THICKNESS SAMPLED:
Feet: 1.5 Meters: 0.4

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: 78-CGS-6

ANALYSES LABORATORY NUMBERS
USBM/DOE: K88639
USGS: D205238

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 3.5 Meters: 1.1

THICKNESS SAMPLED:
Feet: 3.5 Meters: 1.1

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: 78-CGS-8

ANALYSES LABORATORY NUMBERS
USBM/DOE: K88640
USGS: D205239

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 1.9 Meters: 0.6

THICKNESS SAMPLED:
Feet: 1.9 Meters: 0.6

TYPE OF SAMPLE: Coal-channel

PAGOSA SPRINGS FIELD

ARCHULETA COUNTY

SAMPLE NUMBERS: 78-CGS-9,11,13

COAL BED NAME: "B"

GEOLOGIC ROCK UNIT: Upper Fruitland

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: 11.5 Meters: 3.6

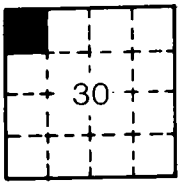
OVERBURDEN AT SAMPLING POINT:
Feet: 10.0 Meters: 3.0

STRIKE: N 50°W

DIP: 12°NE

MAJOR CLEAT ORIENTATION IN COAL:
Face: N 80°E
Butt: 12°NE

LOCATION IN SECTION



SECTION: 30

TOWNSHIP: 33 1/2 N

RANGE: 4 W

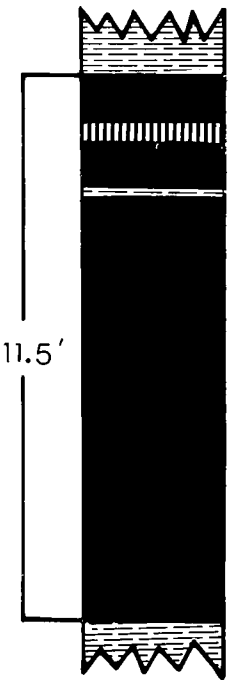
USGS TOPOGRAPHIC QUADRANGLE:
Chimney Rock 7.5' (1968)

MINE NAME: Martinez Strip

MINE TYPE: Surface

OPERATOR/OWNER: Chimney Rock Coal Co.

"B" COAL BED



SHALE: gray, irregular laminations, blocky, fossiliferous.

2.0' COAL: Sample No. 78-CGS-9, moderate thin to thick vitrain bands in medium bright attritus.

0.5' SHALY COAL: abundant vitrain bands, blocky, hard.

1.0' COAL: Sample No. 78-CGS-11, abundant thin to thick vitrain bands in medium bright attritus.

0.3' CARBONACEOUS SHALE: gray.

7.7' COAL: Sample No. 78-CGS-13, as above, abundant peacock colored sulfate mineralization, gypsum filled cleats.

CARBONACEOUS SHALE: dark gray to black, gradational contact.

SAMPLE NUMBER: 78-CGS-9

ANALYSES LABORATORY NUMBERS
USBM/DOE: K88635
USGS: D205234

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 2.0 Meters: 0.6

THICKNESS SAMPLED:
Feet: 2.0 Meters: 0.6

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: 78-CGS-11

ANALYSES LABORATORY NUMBERS
USBM/DOE: K88636
USGS: D205235

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 1.0 Meters: 0.3

THICKNESS SAMPLED:
Feet: 1.0 Meters: 0.3

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: 78-CGS-13

ANALYSES LABORATORY NUMBERS
USBM/DOE: K88637
USGS: D205236

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 7.7 Meters: 2.3

THICKNESS SAMPLED:
Feet: 7.7 Meters: 2.3

TYPE OF SAMPLE: Coal-channel

ARCHULETA COUNTY

SAMPLE NUMBER: 78-CGS-14

COAL BED NAME: "A" Seam

GEOLOGIC ROCK UNIT: Upper Fruitland

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: 25 Meters: 7.6

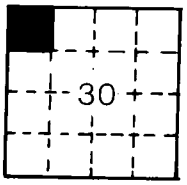
OVERBURDEN AT SAMPLING POINT:
Feet: 10 Meters: 3

STRIKE: N 50°W

DIP: 12°NE

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 30

TOWNSHIP: 33 1/2 N

RANGE: 4 W

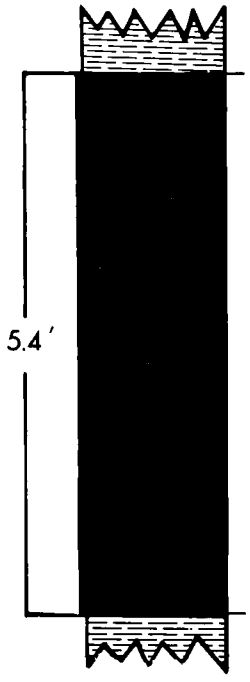
USGS TOPOGRAPHIC QUADRANGLE:
Chimney Rock 7.5' (1968)

MINE NAME: Martinez Strip

MINE TYPE: Surface

OPERATOR/OWNER: Chimney Rock Coal Co.

"A" COAL BED



SANDSTONE: very fine grained, grading upward into gray shale, carbonized wood fragments, sharp basal contact.

COAL: Sample No. 78-CGS-14, banded, moderate thin to thick vitrain in moderately bright attritus, gradational basal contact.

CARBONACEOUS SHALE: gray to brown, irregular laminations, blocky, fossiliferous.

ANALYSES LABORATORY NUMBERS
USBM/DOE: K88634
USGS: D205233

APPARENT RANK OF COAL:
High-volatile B bituminous

THICKNESS OF COAL:
Feet: 5.4 Meters: 1.6

THICKNESS SAMPLED:
Feet: 5.4 Meters: 1.6

TYPE OF SAMPLE: Coal-channel

Table E1. Proximate and ultimate analyses, heat-of-combustion, forms-of-sulfur, free-swelling-index and ash-fusion-temperature determinations for 12 coal samples from the San Juan Region, Colorado.

[All analyses except heat-of-combustion, free-swelling index, and ash-fusion temperatures in percent. For each sample number, the analyses are reported three ways: first, as received; second, moisture free; and third, moisture and ash free. All analyses by Coal Analysis Section, U.S. Department of Energy, Pittsburgh, Pa. °F = (°C x 1.8) + 32; Kcal/kg = 0.556 (Btu/lb), L, less than the value shown]

	Proximate Analysis				Ultimate Analysis					Heat of Combustion	
Sample number	Moisture	Volatile matter	Fixed carbon	Ash	Hydrogen	Carbon	Nitrogen	Oxygen	Sulfur	Kcal/kg	Btu/lb
D180093	3.4	34.7	52.2	9.7	5.3	71.0	1.5	11.8	0.7	7,060	12,700
	---	35.9	54.0	10.0	5.1	73.5	1.6	9.1	.7	7,300	13,150
	---	39.9	60.1	---	5.7	81.7	1.7	10.1	.8	8,120	14,620
D180094	3.1	32.0	47.7	17.2	4.9	65.2	1.4	10.6	.7	6,480	11,660
	---	33.0	49.2	17.8	4.7	67.3	1.4	8.1	.7	6,680	12,030
	---	40.2	59.8	---	5.7	81.8	1.8	9.8	.9	8,130	14,630
D205233	4.9	27.7	54.2	13.2	5.2	67.3	1.4	12.1	.8	6,520	11,740
	---	29.1	57.0	13.9	4.9	70.8	1.5	8.1	.8	6,860	12,340
	---	33.8	66.2	---	5.7	82.2	1.7	9.5	1.0	7,960	14,330
D205234	1.5	31.0	56.7	10.8	5.3	75.7	1.6	5.7	.9	7,520	13,530
	---	31.5	57.6	11.0	5.2	76.9	1.6	4.4	.9	7,630	13,740
	---	35.3	64.7	---	5.9	86.3	1.8	5.0	1.0	8,570	15,430
D205235	1.2	31.3	57.7	9.8	5.5	76.7	1.7	5.4	.8	7,620	13,720
	---	31.7	58.4	9.9	5.4	77.6	1.7	4.4	.8	7,720	13,890
	---	35.2	64.8	---	6.0	86.2	1.9	4.9	.9	8,570	15,420
D205236	1.2	30.4	57.6	10.8	5.4	75.7	1.6	5.7	.8	7,600	13,670
	---	30.8	58.3	10.9	5.3	76.6	1.6	4.7	.8	7,690	13,840
	---	34.5	65.5	---	6.0	86.0	1.8	5.3	.9	8,630	15,540
D205237	1.5	29.1	54.0	15.4	5.1	71.1	1.4	6.1	.9	7,070	12,730
	---	29.5	54.8	15.6	5.0	72.2	1.4	4.8	.9	7,180	12,920
	---	35.0	65.0	---	5.9	85.6	1.7	5.7	1.1	8,510	15,310
D205238	1.4	28.8	54.5	15.3	5.2	71.6	1.4	5.7	.8	7,090	12,760
	---	29.2	55.3	15.5	5.1	72.6	1.4	4.5	.8	7,190	12,940
	---	34.6	65.4	---	6.1	86.0	1.7	5.3	1.0	8,510	15,320
D205239	2.3	25.5	45.1	27.1	4.6	59.7	1.2	6.7	.9	5,950	10,710
	---	26.1	46.2	27.7	4.4	61.1	1.2	4.8	.9	6,090	10,960
	---	36.1	63.9	---	6.2	84.6	1.7	6.6	1.3	8,430	15,170
D205240	3.8	37.9	52.9	5.4	5.7	72.9	1.6	13.5	.8	7,270	13,080
	---	39.4	55.0	5.6	5.5	75.8	1.7	10.5	.8	7,550	13,600
	---	41.7	58.3	---	5.8	80.3	1.8	11.1	.9	8,000	14,410
D205241	5.7	31.3	55.7	7.3	5.3	72.9	1.1	12.7	.8	7,040	12,670
	---	33.2	59.1	7.7	4.9	77.3	1.2	8.1	.8	7,460	13,430
	---	36.0	64.0	---	5.4	83.8	1.3	8.8	.9	8,090	14,560
D205242	4.6	31.6	54.4	9.4	3.6	75.6	1.1	9.5	0.8	7,000	12,590
	---	33.1	57.0	9.9	3.2	79.2	1.2	5.7	.8	7,330	13,200
	---	36.7	63.3	---	3.6	87.9	1.3	6.3	.9	8,140	14,640

Table E1. Proximate and ultimate analyses, heat-of-combustion, forms-of-sulfur, free-swelling-index and ash-fusion-temperature determinations for 12 coal samples from the San Juan Region, Colorado (cont.).

Sample number	Air-dried loss	Forms of sulfur			Free swelling	Ash fusion temperature C		
		Sulfate	Pyritic	Organic		Initial deformation	softening	fluid
D180093	1.1	0.02	0.07	0.56	1.5	1,540	1,540	1,540
	---	.02	.07	.58				
	---	.02	.08	.64				
D180094	.9	.02	.07	.56	1.0	1,540	1,540	1,540
	---	.02	.07	.58				
	---	.03	.09	.70				
D205233	3.2	.01	.06	.75	1.0	1,430	1,495	1,600
	---	.01	.06	.79				
	---	.01	.07	.92				
D205234	.7	.01	.11	.73	8.5	1,265	1,325	1,375
	---	.01	.11	.74				
	---	.01	.13	.83				
D205235	.5	.01	.07	.72	8.5	1,515	1,600	1,600
	---	.01	.07	.73				
	---	.01	.08	.81				
D205236	.5	.01	.09	.71	8.5	1,600	1,600	1,600
	---	.01	.09	.72				
	---	.01	.10	.81				
D205237	.8	.01	.17	.68	8.5	1,600	1,600	1,600
	---	.01	.17	.69				
	---	.01	.20	.82				
D205238	.7	.01	.16	.63	8.5	1,600	1,600	1,600
	---	.01	.16	.64				
	---	.01	.19	.76				
D205239	1.4	.01	.29	.57	8.0	1,600	1,600	1,600
	---	.01	.30	.58				
	---	.01	.41	.81				
D205240	1.6	.01	.09	.73	1.0	1,600	1,600	1,600
	---	.01	.09	.76				
	---	.01	.10	.80				
D205241	4.2	.01	.12	.63	1.0	1,600	1,600	1,600
	---	.01	.13	.67				
	---	.01	.14	.72				
D205242	3.0	0.01	0.22	0.53	1.0	1,600	1,600	1,600
	---	.01	.23	.56				
	---	.01	.26	.62				

Table E2. Major- and minor-oxide and trace element composition of the laboratory ash of 12 coal and coal-associated rock samples from the San Juan Region, Colorado.

[Values in percent or parts per million. Coal and shale ashed at 525°C. S after element title indicates determinations by semiquantitative emission spectrography. The spectrographic results are to be identified with geometric brackets whose boundaries are part of the ascending series 0.12, 0.18, 0.26, 0.38, 1.2, etc. but reported as midpoints of the brackets, 0.1, 0.15, 0.2, 0.3, 0.5, 0.7, 1.0, etc. Precision of the spectrographic data is plus-or-minus one bracket at 68 percent or plus-or-minus two brackets at 95 percent confidence level. L, less than the value shown; N, not detected].

Sample number	Ash (percent)	SiO2 (percent)	Al2O3 (percent)	CaO (percent)	MgO (percent)	Na2O (percent)	K2O (percent)	Fe2O3 (percent)	TiO2 (percent)	P2O5 (percent)	Sample number
D180093	10.9	69	23	0.89	0.36	0.27	0.45	2.2	1.4	1.0L	D180093
D180094	18.5	73	18	.24	.60	.19	1.0	2.4	1.2	1.0L	D180094
D205233	14.1	62	23	2.0	.86	.26	.41	4.3	.90	.090	D205233
D205234	11.5	54	21	7.4	1.29	.31	.24	4.2	.77	.13	D205234
D205235	10.6	71	19	.56	.78	.26	.24	2.7	.62	.010L	D205235
D205236	11.3	62	25	1.3	.63	.43	.24	3.6	1.0	.080	D205236
D205237	15.9	58	30	1.5	.70	.31	.54	5.0	1.3	.11	D205237
D205238	16.5	58	28	1.2	.63	.34	.49	3.3	1.5	.090	D205238
D205239	28.3	62	25	.70	.70	.61	.92	2.7	.92	.010L	D205239
D205240	5.5	51	36	.84	.28	.61	.12	4.6	1.3	.010L	D205240
D205241	8.5	58	30	.70	.27	.12	.12	4.6	1.7	.010L	D205241
D205242	10.5	51	34	2.5	.48	.11	.24	4.7	1.7	.010L	D205242

Sample number	SO3 (percent)	B-S (ppm)	Ba-S (ppm)	Be-S (ppm)	Cd (ppm)	Co-S (ppm)	Cr-S (ppm)	Cu (ppm)	Ga-S (ppm)	La-S (ppm)	Sample number
D180093	0.39	500	500	15	1.0L	50	70	71	30	100	D180093
D180094	.20L	200	300	7	1.0L	15	50	59	30	100L	D180094
D205233	1.1	100	1,500	7	1.0L	B	B	116	30	100L	D205233
D205234	1.7	150	1,500	3	1.0L	B	B	59	30	100L	D205234
D205235	.50	150	1,500	3	1.0L	B	B	49	20	100	D205235
D205236	.50	150	1,500	3	1.0L	B	B	66	30	100L	D205236
D205237	.25	100	2,000	3	1.0L	B	B	86	30	100L	D205237
D205238	.25	100	1,500	3	1.0L	B	B	92	30	100L	D205238
D205239	.25	70	2,000	7	1.0L	B	B	64	30	100L	D205239
D205240	.25	1,500	500	7	1.0L	B	B	80	50	150	D205240
D205241	.50	300	150	7	2.0	B	B	124	50	150	D205241
D205242	.50	300	200	7	1.0L	B	B	89	30	100L	D205242

Table E2. Major- and minor-oxide and trace element composition of the laboratory ash of 12 coal and coal-associated rock samples from the San Juan Region, Colorado (cont.).

Sample number	Li (ppm)	Mn (ppm)	Mo-S (ppm)	Nb-S (ppm)	Nd-S (ppm)	Ni-S (ppm)	Pb (ppm)	Sc-S (ppm)	Sr-S (ppm)	V-S (ppm)	Sample number
D180093	161	50	10	50	150L	50	100	20	500	150	D180093
D180094	63	70	7	50	N	15	50	15	150	150	D180094
D205233	71	60	10	30	N	20	37	20	300	70	D205233
D205234	82	120	10	20	N	15	29	10	700	70	D205234
D205235	90	87	15	30	N	15	25L	10	500	30	D205235
D205236	133	95	7	30	N	15	38	15	300	30	D205236
D205237	172	130	10	30	N	20	64	15	300	30	D205237
D205238	154	92	7	30	N	20	32	15	300	70	D205238
D205239	107	93	N	30	N	15	58	15	200	50	D205239
D205240	215	92	10	70	150	100	49	30	500	50	D205240
D205241	147	81	15	50	150	70	51	50	150	100	D205241
D205242	190	121	15	50	N	50	62	30	100	50	D205242

Sample number	Y-S (ppm)	Yb-S (ppm)	Zn (ppm)	Zr-S (ppm)
D180093	70	7	97	300
D180094	70	7	107	200
D205233	50	5	115	300
D205234	50	5	54	150
D205235	50	3	35	200
D205236	30	3	18	200
D205237	30	3	42	200
D205238	30	3	38	200
D205239	30	3	151	200
D205240	70	7	53	300
D205241	100	10	184	300
D205242	70	7	46	300

Table E3. Content of 9 trace elements in 12 coal and coal-associated rock samples from the San Juan Region, Colorado.

[Analyses on air-dried (32°C) coal and shale. L, less than the value shown]

Sample number	As (ppm)	Co (ppm)	Cr (ppm)	F (ppm)	Hg (ppm)	Sb (ppm)	Se (ppm)	Th (ppm)	U (ppm)	Sample number
D180093	0.5	B	B	85	0.08	1.0	1.5	1.7	1.6	D180093
D180094	1.5	B	B	65	.07	.8	1.6	4.3	2.0	D180094
D205233	.4	1.9	2.0	170	.04	.2	1.0	2.6	.8	D205233
D205234	.1L	1.3	2.1	180	.01	.3	.6	2.5	.8	D205234
D205235	.1L	1.6	1.5	40	.01L	.3	.7	1.4	.9	D205235
D205236	.2	1.2	2.5	130	.01	.2	.9	2.3	.8	D205236
D205237	.2	2.2	3.8	170	.01	.2	1.5	2.6	.9	D205237
D205238	.1	2.2	4.1	140	.01	.2	1.7	2.8	.8	D205238
D205239	.2	3.2	4.3	130	.02	.2	1.1	3.1	1.1	D205239
D205240	.7	.6	1.8	20	.02	.1	1.9	2.2	1.2	D205240
D205241	.2	1.3	4.6	30	.02	.6	1.8	3.1	1.5	D205241
D205242	.3	1.7	3.7	45	.02	.5	2.4	3.6	2.1	D205242

Table E4. Major-, minor- and trace-element composition of 12 coal and coal-associated rock samples from the San Juan Region, Colorado.

[Values in percent or parts per million. As, Co, Cr, F, Hg, Sb, Se, Th, and U values are from direct determinations on air-dried (32°C) coal and shale; all other values calculated from analyses of ash. S means analysis by emission spectrography; L, less than the value shown; N, not detected].

Sample number	Si (percent)	Al (percent)	Ca (percent)	Mg (percent)	Na (percent)	K (percent)	Fe (percent)	Ti (percent)	As (ppm)	B-S (ppm)	Sample number
D180093	3.5	1.3	0.069	0.024	0.022	0.041	0.17	0.090	0.5	50	D180093
D180094	6.3	1.8	.032	.067	.026	.16	.31	.13	1.5	30	D180094
D205233	4.1	1.7	.20	.073	.027	.048	.42	.076	.4	15	D205233
D205234	2.9	1.3	.61	.089	.026	.023	.33	.053	.1L	15	D205234
D205235	3.5	1.1	.042	.050	.020	.021	.20	.039	.1L	15	D205235
D205236	3.3	1.5	.10	.043	.036	.023	.28	.069	.2	15	D205236
D205237	4.3	2.5	.17	.067	.037	.072	.56	.12	.2	15	D205237
D205238	4.5	2.5	.14	.063	.042	.067	.38	.14	.1	15	D205238
D205239	8.2	3.7	.14	.12	.13	.22	.54	.16	.2	20	D205239
D205240	1.3	1.0	.033	.009	.025	.006	.18	.044	.7	70	D205240
D205241	2.3	1.4	.042	.014	.008	.009	.27	.085	.2	20	D205241
D205242	2.5	1.9	.19	.030	.009	.021	.35	.10	.3	30	D205242

Sample number	Ba-S (ppm)	Be-S (ppm)	Cd (ppm)	Co (ppm)	Cr (ppm)	Cu (ppm)	F (ppm)	Ga-S (ppm)	Hg (ppm)	La-S (ppm)	Sample number
D180093	50	1.5	0.11L	5	7	7.7	85	3	0.08	10	D180093
D180094	50	1.5	.19L	3	10	11	65	5	.07	20L	D180094
D205233	200	1	.14L	1.9	2.0	16	170	5	.04	15L	D205233
D205234	150	.3	.12L	1.3	2.1	6.8	180	3	.01	10L	D205234
D205235	150	.3	.11L	1.6	1.5	5.2	40	2	.01L	10	D205235
D205236	150	.3	.11L	1.2	2.5	7.5	130	3	.01	10L	D205236
D205237	300	.5	.16L	2.2	3.8	14	170	5	.01	15L	D205237
D205238	200	.5	.17L	2.2	4.1	15	140	5	.01	15L	D205238
D205239	700	2	.28L	3.2	4.3	18	130	10	.02	30L	D205239
D205240	30	.5	.06L	.6	1.8	4.4	20	3	.02	7	D205240
D205241	15	.7	.17	1.3	4.6	11	30	5	.02	15	D205241
D205242	20	.7	.11L	1.7	3.7	9.3	45	3	.02	10L	D205242

Table E4. Major-, minor- and trace-element composition of 12 coal and coal-associated rock samples from the San Juan Region, Colorado (cont.).

Sample number	Li (ppm)	Mn (ppm)	Mo-S (ppm)	Nb-S (ppm)	Nd-S (ppm)	Ni-S (ppm)	P (ppm)	Pb (ppm)	Sb (ppm)	Sc-S (ppm)	Sample number
D180093	18	5.5	1	5	15L	5	480L	11	1.0	2	D180093
D180094	12	13	1.5	10	N	3	810L	9.3	.8	3	D180094
D205233	10	8.5	1.5	5	N	3	55	5.2	.2	3	D205233
D205234	9.4	14	1	2	N	1.5	65	3.3	.3	1	D205234
D205235	9.5	9.2	1.5	3	N	1.5	5L	2.7L	.3	1	D205235
D205236	15	11	.7	3	N	1.5	40	4.3	.2	1.5	D205236
D205237	27	21	1.5	5	N	3	76	10	.2	2	D205237
D205238	25	15	1	5	N	3	65	5.3	.2	2	D205238
D205239	30	26	N	10	N	5	12L	16	.2	5	D205239
D205240	12	5.1	.5	5	7	5	2L	2.7	.1	1.5	D205240
D205241	12	6.9	1.5	5	15	7	4L	4.3	.6	5	D205241
D205242	20	13	1.5	5	N	5	5L	6.5	.5	3	D205242

Sample number	Se (ppm)	Sr-S (ppm)	Th (ppm)	U (ppm)	V-S (ppm)	Y-S (ppm)	Yb-S (ppm)	Zn (ppm)	Zr-S (ppm)	Sample number
D180093	1.5	50	1.7	1.6	15	7	0.7	11	30	D180093
D180094	1.6	30	4.3	2.0	30	15	1.5	20	30	D180094
D205233	1.0	50	2.6	.8	10	7	.7	16	50	D205233
D205234	.6	70	2.5	.8	7	7	.7	6.2	15	D205234
D205235	.7	50	1.4	.9	3	5	.3	3.7	20	D205235
D205236	.9	30	2.3	.8	3	3	.3	2.0	20	D205236
D205237	1.5	50	2.6	.9	5	5	.5	6.7	30	D205237
D205238	1.7	50	2.8	.8	10	5	.5	6.3	30	D205238
D205239	1.1	70	3.1	1.1	15	10	1	43	70	D205239
D205240	1.9	30	2.2	1.2	3	5	.5	2.9	15	D205240
D205241	1.8	15	3.1	1.5	10	10	1	16	20	D205241
D205242	2.4	10	3.6	2.1	5	7	.7	4.8	30	D205242

Table E5. Arithmetic mean, observed range, geometric mean, and geometric deviation of proximate and ultimate analyses, heat of combustion, forms of sulfur, and ash-fusion temperatures of 12 coal samples from the San Juan Region, La Plata, Montrose, and Archuleta Counties, Colorado.

[All values are in percent except Kcal/kg, Btu/lb, ash-fusion temperatures, and geometric deviation and are reported on the as-received basis. °F = (C° x 1.8) + 32; Kcal/kg = 0.556 (Btu/lb)]

	Arithmetic mean	Observed range		Geometric mean	Geometric deviation
		Minimum	Maximum		
Proximate and Ultimate Analyses					
Moisture	2.9	1.2	5.7	2.5	1.8
Volatile matter	31.0	25.5	37.9	30.8	1.1
Fixed Carbon	53.6	45.1	57.7	53.4	1.1
Ash	12.7	5.4	27.1	11.6	1.5
Hydrogen	5.1	3.6	5.7	5.1	1.1
Carbon	71.3	59.7	76.7	71.1	1.1
Nitrogen	1.4	1.1	1.7	1.4	1.2
Oxygen	8	5.4	13.5	8.3	1.4
Sulfur	.8	.7	.9	.8	1.1
Heat of Combustion					
Kcal/kg	7,020	5,950	7,620	7,005	1.1
Btu/lb	12,630	10,710	13,720	12,600	1.1
Forms of sulfur					
Sulfate	0.01	0.01	0.02	0.01	1.3
Pyritic	.12	.06	.29	.11	1.7
Organic	.65	.53	.75	.64	1.1
Ash-fusion temperatures, °C					
Initial deformation	1,540	1,265	1,600	1,535	1.1
Softening temperature	1,555	1,325	1,600	1,555	1.1
Fluid temperature	1,570	1,325	1,600	1,570	1.0

Table E6. Arithmetic mean, observed range, geometric mean, and geometric deviation of 36 elements in 12 coal samples from the San Juan Region, La Plata, Montrose, and Archuleta Counties, Colorado.

[All analyses are in percent or parts per million and are reported on a whole-coal basis. As, F, Hg, Sb, Se, Th, and U values used to calculate the statistics were determined directly on whole coal. All other values used were calculated from determinations made on coal ash. L, less than the value shown]

Element	Arithmetic mean	Observed range		Geometric mean	Geometric deviation
		Minimum	Maximum		
Si	3.9	1.3	8.2	3.5	1.6
Al	1.9	1.0	3.7	1.7	1.5
Ca	.15	.032	.61	.10	2.5
Mg	.057	.009	.12	.043	2.2
Na	.034	.008	.13	.026	2.1
K	.062	.006	.22	.035	3.0
Fe	.34	.17	.56	.31	1.5
Ti	.094	.039	.16	.085	1.6
	Parts per million				
As	.4	0.1L	1.5	.02	2.7
B	20	15	70	20	1.7
Ba	200	15	700	100	3.2
Be	.7	.3	2	.7	1.9
Cd	--	.06L	.17	--	--
Cu	11	4.4	18	9.6	1.6
F	106	20	180	80	2.1
Ga	5	2	10	4	1.5
Hg	.03	.01L	.08	.02	2.3
La	7	7	15	5.5	1.8
Li	17	9.4	30	15	1.5
Mn	12	5.1	26	11	1.7
Mo	1	.5	1.5	1	1.6
Nb	5	2	10	5	1.6
Ni	3	1.5	7	3	1.7
P	41	2L	76	36.1	1.7
Pb	6.8	2.7L	16	5.6	1.9
Sb	.4	.1	1	.3	2.0
Sc	2	1	5	2	1.7
Se	1.4	.6	2.4	1.3	1.5
Sr	50	10	70	30	1.8
Th	2.7	1.4	4.3	2.6	1.4
U	1.2	.8	2.1	1.1	1.4
V	10	3	30	7	2.1
Y	7	3	15	7	1.5
Yb	.7	.3	1.5	.7	1.6
Zn	12	2	43	7.9	2.4
Zr	30	15	70	30	1.6

Table E7. Arithmetic mean, observed range, geometric mean, and geometric deviation of ash content and contents of ten major and minor oxides in the laboratory ash of 12 coal samples from the San Juan Region, La Plata, Montrose and Archuleta Counties, Colorado.

[All samples were ashed at 525°C; all analyses except geometric deviation are in percent; L, less than the value shown]

Oxide	Arithmetic mean	Observed range		Geometric mean	Geometric deviation
		Minimum	Maximum		
(Ash)	13.6	5.5	28.3	12.5	1.5
SiO_2	60	51	73	60	1.1
Al_2O_3	26	18	36	25	1.3
CaO	1.6	.24	7.4	1.1	2.4
MgO	.64	.27	1.3	.58	1.6
Na_2O	.32	.11	.61	.28	1.7
K_2O	.43	.12	1	.34	2.0
Fe_2O_3	3.7	2.2	5	3.6	1.3
TiO_2	1.2	.62	1.7	1.1	1.4
SO_3	.52	.20L	1.7	.42	1.9

Section F
Chemical Analyses of Coal Samples from the
Uinta Region

Figure F1. An abandoned coal mine shaft in the Uinta Region.

Uinta Region

The Uinta coal region is located in northwest Colorado and northeast Utah. The Colorado portion of the region extends from the Axial Basin uplift in the North to Book Cliffs and the West Elk Mountains in the South and from the Utah-Colorado boundary East to the Elk Mountains and the Grand Hogback (see figure F2). The Uinta region encompasses the Piceance Creek Basin, which is known for its oil and gas reserves. The regional structure is dominated by a broad northwest - southeast synclinal trend with moderate to steeply dipping strata along the basin margin. The stratigraphy of the region, including formation names, bed thickness, and ages varies as to area. For a general overview of regional differences in formation names and ages, see figure 2, Part I, (Colorado Stratigraphic Correltion Chart) which includes three columns for different areas within the Uinta region. Coals occur in the Mesaverde Group of the upper Cretaceous (see figures F3, F4 and F5).

Analyses for 136 coal and associated rock samples from 25 mines and 23 drill holes are included from this region. This information is divided into two sections. This sections deals with 91 samples from 26 locations (16 mines and 10 drill holes) in the Carbondale, Cathedral (gas), Crested Butte, Danforth Hills, Grand Hogback, and Somerset coal fields. The remaining samples are listed in the next section which deals only with the Grand Mesa coal field. This next section is reprinted from U.S. Geological Survey open-file report 80-980. In this section there are 49 coal samples which have not been analyzed for trace element content. The proximate and ultimate analyses for these samples are contained in a special table at the end of this section. The statistical summaries do not reflect this data. The rank of the coal samples in the region ranges from subbituminous A coal to semianthracite coal in the region. Although the range of sulfur values varies from a low of 0.3 percent to a high of 2.5 percent (83 samples), the arithmetic mean is still very low at 0.6 percent. The ash content for these samples exhibits a wide range of values starting as low as 1.9 percent and is usually below 10 percent in mined seams. However, many impure coal samples with ash contents ranging as high as 46 percent were collected from drill cores.

The historical records show that there have been 297 coal mines in the Uinta region which have produced over 100 million tons of coal (Boreck and Murray, 1979). In 1979 the region produced over 6 million tons of coal from 24 mines. According to Boreck and Murray (1979) the remaining demonstrated coal reserve base in the region is about 3 billion tons.

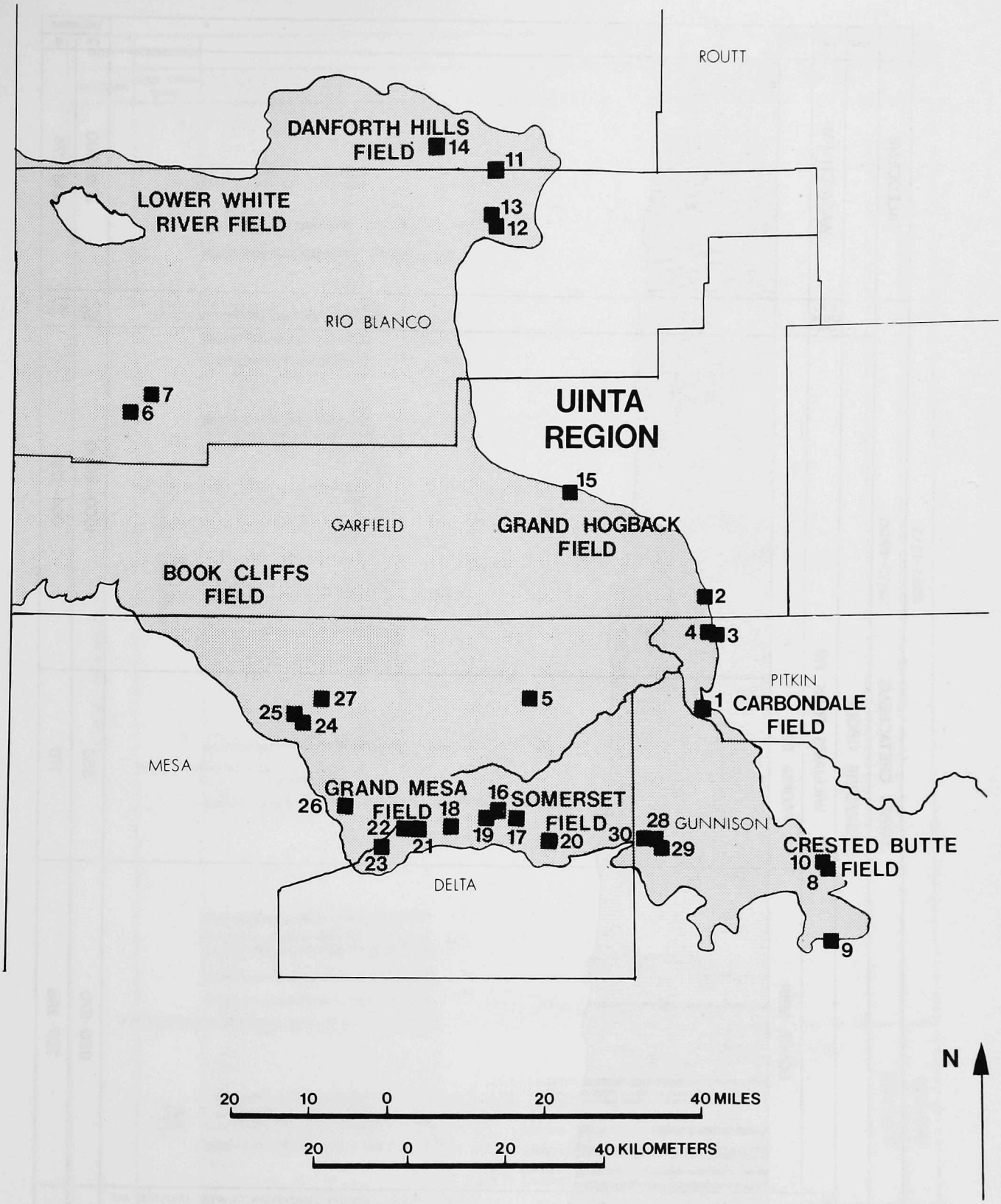


Figure F2. Location of samples within the Uinta Region.

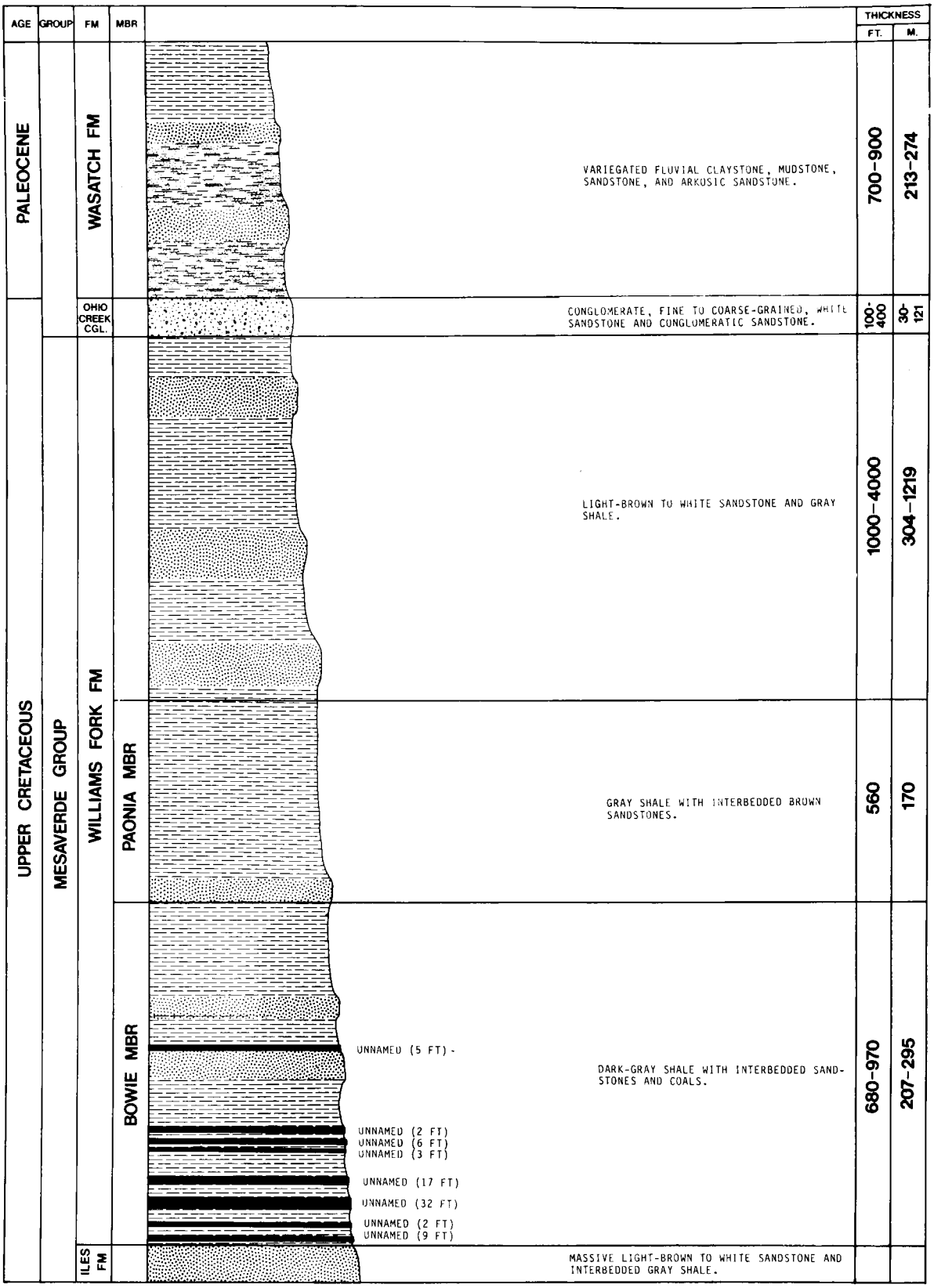


Figure F3. Generalized stratigraphic section of coal-bearing rocks in the Uinta Region, Carbondale field. Coal beds shown in black (after Boreck and Murray, 1979; Cashion, 1973; Collins, 1976; Hornbaker and others, 1976).

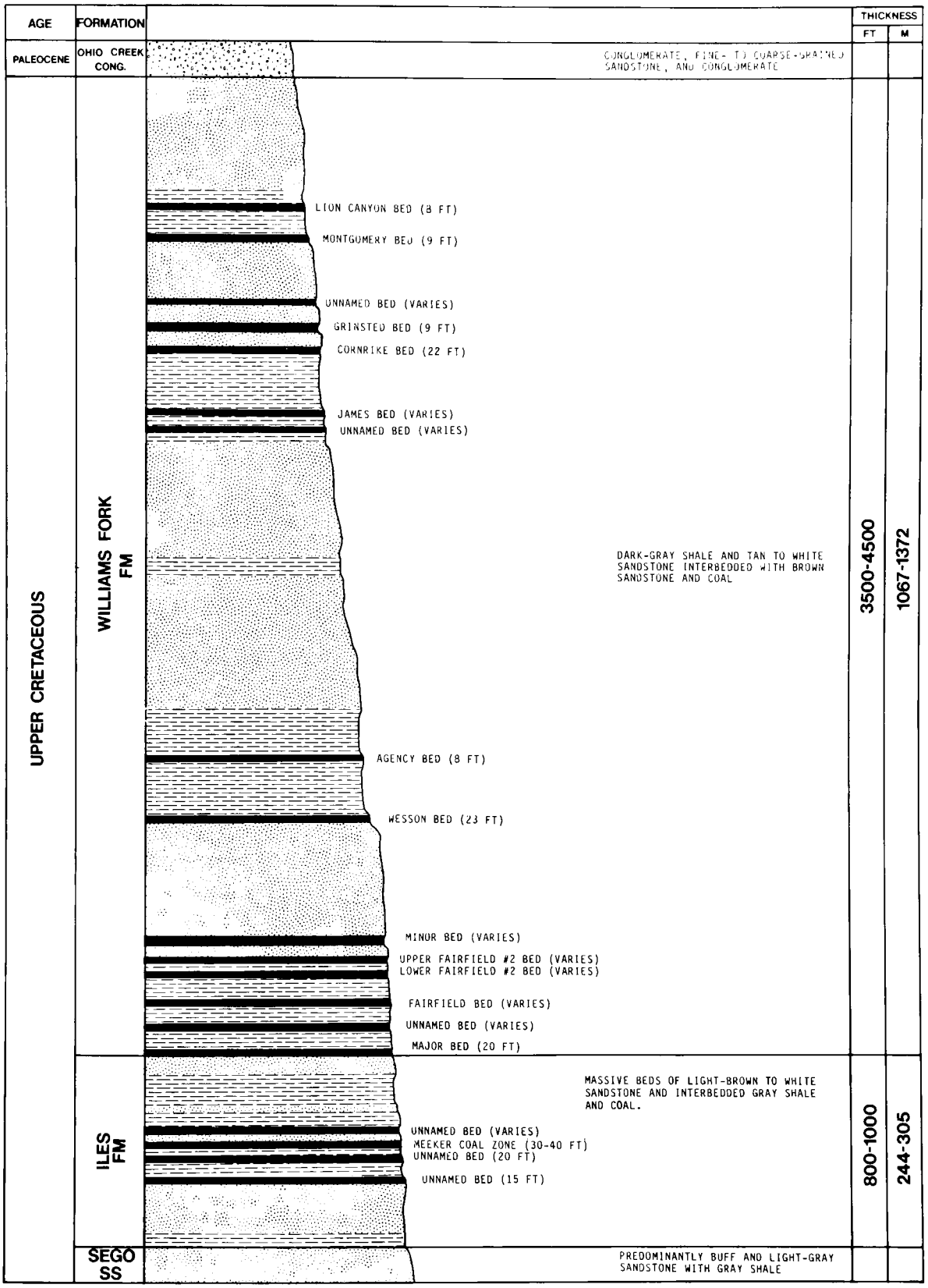


Figure F4. Generalized stratigraphic section of coal-bearing rocks in the Uinta Region, Danforth Hills field. Coal beds shown in black (after Boreck and Murray, 1979; Collins, 1976; Hornbaker and others, 1976).

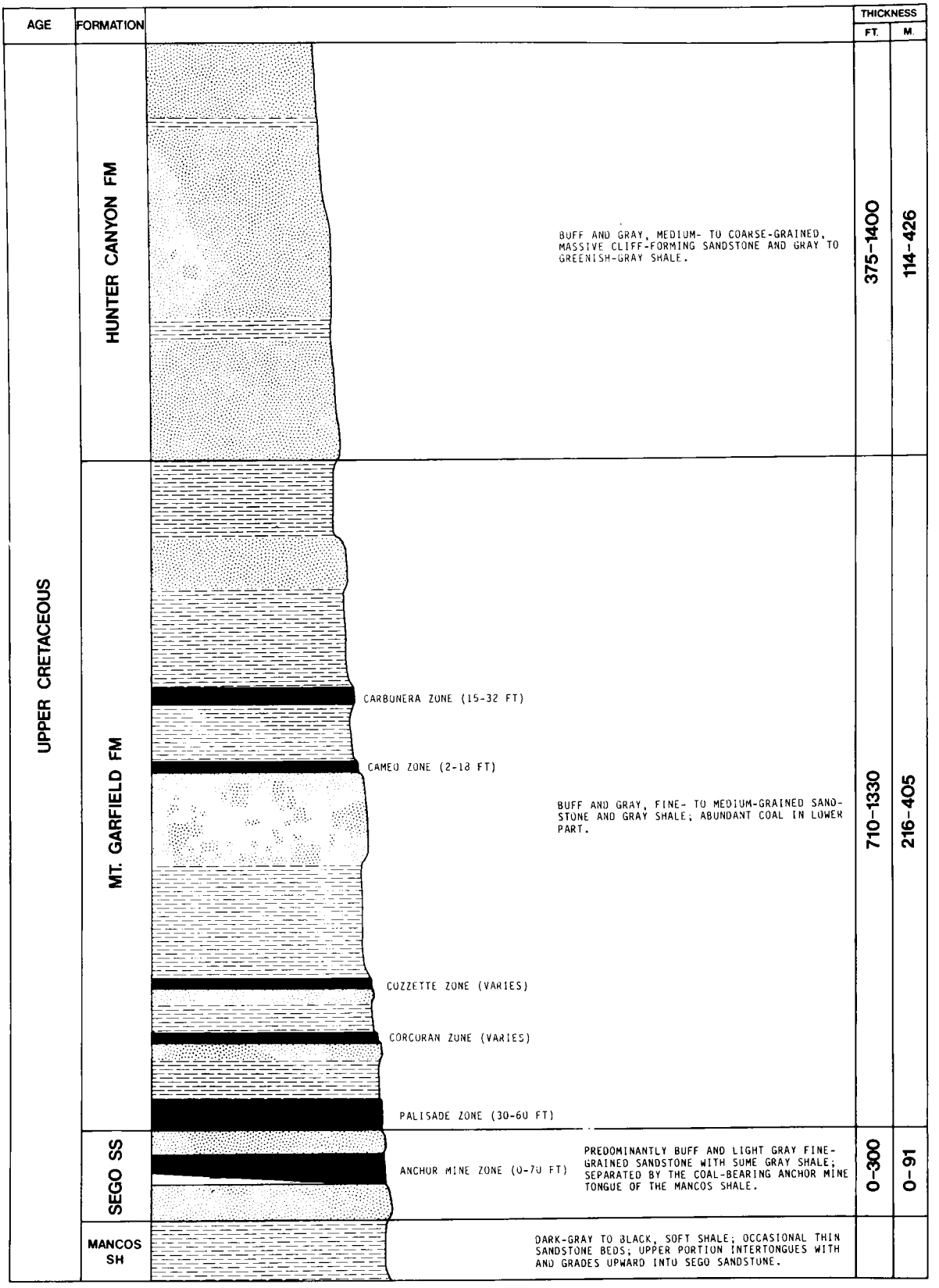


Figure F5. Generalized stratigraphic section of coal-bearing rocks in the Uinta Region, Book Cliffs, Grand Hogback, Grand Mesa, and Somerset Fields. Coal zones shown in black (after Boreck and Murray, 1979; Cashion, 1973; Schwochow, 1978).

MAP INDEX #	FIELD/AREA	COUNTY	LOCATION SEC.	TWP.	RGE.	CGS SAMPLE #	USGS SAMPLE #	US DOE SAMPLE #	SAMPLE TYPE
1	Carbondale	Pitkin	15	10S	89W	77-DJ-18	D196222	K84727	Channel
						77-DJ-19	D196221	K84726	Channel
						77-DJ-20	D196438		Channel
1			17	10S	89W	76-DJ-19	D184637	K69860	Channel
						76-DJ-20	D184638	K69860	Channel
1			16	10S	89W	77-DJ-15	D196219	K84724	Channel
						77-DJ-16	D196437		Parting
						77-DJ-17	D196220	K84775	Channel
2		Garfield	34	7S	89W	76-DJ-7	D184636	K69859	Tipple
3		Pitkin	35	8S	89W	78-CGS-20	D208589	K92112	Channel
						78-CGS-21	D208589	K92112	Channel
						78-CGS-22	D208589	K92112	Channel
4			34	8S	89W	78-CGS-23	D208590	K92113	Channel
						78-CGS-24	D208590	K92113	Channel
						78-CGS-25	D208590	K92113	Channel
1			8	10S	89W	77-DJ-21	D196223	K84728	Channel
5		Mesa	10	10S	93W	Core 2		K99779	Core
						Core 3		K99780	Core
6	Cathedral	Rio Blanco	28	3S	101W	78-CGS-33		K90196	Core
						78-CGS-29		K90197	Core
7			14	3S	101W	27		K92140	Core
						29		K92139	Core
						38		K92143	Core
						36		K92141	Core
						24		K92142	Core
8	Crested	Gunnison	33	13S	86W	78-CGS-18	D208587	K92110	Grab
9	Butte		16	15S	86W	78-CGS-17	D208586	K92109	Channel
10			28	13S	86W	78-CGS-19	D208588	K92111	Grab

Figure F6. Sample index for the Uinta Region. (Map index number refers to figure F2.)

MAP INDEX #	FIELD/AREA	COUNTY	LOCATION SEC.	TWP.	RGE.	CGS SAMPLE #	USGS SAMPLE #	US DOE SAMPLE #	SAMPLE TYPE
11	Danforth Hills	Moffat	4	3N	93W	Y_3			Core
						Y_2			Core
						X^2			Core
						A_2			Core
						A_3			Core
						B			Core
						C			Core
						D			Core
						E			Core
						F			Core
12		Rio Blanco	29	2N	93W	78-NBR-1	D208585	K92108	Tipple
13			21	2N	93W	CGS Core 1		K76536	Core
14		Moffat	18	4N	94W	Run 1		K89044	Core
						Run 2		K89045	Core
						Run 3		K89041	Core
						Run 4		K89043	Core
						Run 5		K89046	Core
15	Grand Hogback	Garfield	24	5S	92W	77-DJ-8	D196216	K84721	Channel
						77-DJ-11	D196217	K84722	Channel
						77-DJ-5	D196214	K84719	Channel
						77-DJ-6	D196215	K84720	Channel
						77-DJ-7	D196434		Parting
15			24	5S	92W	77-DJ-12	D196218	K84723	Channel
						77-DJ-13	D196435		Roof
						77-DJ-14	D196436		Floor
16	Grand Mesa	Delta	8	13S	93W		D191607		Channel
17	(See Section G)		15	13S	93W		D194452		Channel
17			22	13S	93W		D194453		Channel
18			12	13S	95W		D194454		Channel
18			13	13S	95W		D194455		Channel
19			15	13S	94W		D194456		Channel
20			27	13S	92W		D194457		Channel
20			20	13S	92W		D203116		Core
							D203117		Core
							D203118		Core
							D203119		Core

Figure F6. (cont.)

MAP INDEX #	FIELD/AREA	COUNTY	LOCATION SEC.	TWP.	RGE.	CGS SAMPLE #	USGS SAMPLE #	US DOE SAMPLE #	SAMPLE TYPE
20			19	13S	92W		D203113		Core
							D203114		Core
							D203115		Core
17			24	13S	93W		D203120		Core
16			8	13S	93W		D203109		Core
							D203110		Core
							D203111		Core
							D203112		Core
16			1	13S	94W		D203106		Core
							D203107		Core
							D203108		Core
19			15	13S	94W		D203100		Cuttings
							D203002		Cuttings
							D203003		Cuttings
							D203005		Cuttings
21			8	13S	95W		D203095		Core
22			25	13S	96W		D203096		Core
							D203098		Core
							D203099		Core
22			24	13S	96W		D203091		Core
							D203092		Core
							D203093		Core
							D203094		Core
23			32	13S	96W		D203089		Core
							D203090		Core
24		Mesa	34	10S	98W		D180095		Channel
							D180096		Channel
25			34	10S	98W		D184655		Channel
							D184656		Channel
26			21	12S	97W		D203087		Core
							D203088		Core
27			13	10S	98W		D203083		Core
							D203084		Core
							D203086		Core

Figure F6. (cont.)

MAP INDEX #	FIELD/AREA	COUNTY	LOCATION SEC.	TWP.	RGE.	CGS SAMPLE #	USGS SAMPLE #	US DOE SAMPLE #	SAMPLE TYPE
28	Somerset	Gunnison	9	13S	90W	76-DB-1	D184650	K69867	Channel
						76-DB-2	D184651	K69867	Channel
29			11	13S	90W	WSC #5 1A		K92144	Core
						78-SMG-102	D216420	K99929	Core
						1B		K94209	Core
						1C		K95626	Core
						78-SMG-103	D216424	K99932	Core
						WSC #5 1D		K95630	Core
						78-SMG-106	D216477	K99935	Core
						1E		K92145	Core
						1F		K95971	Core
						1H		K95973	Core
						1I		K95974	Core
						1J		K94210	Core
						78-CGS-106		K94211	Core
						CGS-107		K95632	Core
						CGS-108		K95627	Core
						CGS-109		K95977	Core
						CGS-110		K95975	Core
						CGS-111		K95976	Core
						CGS-112		K95625	Core
						CGS-113		K95628	Core
						CGS-114		K95629	Core
						CGS-115		K95983	Core
						CGS-116			Core
						CGS-117		K95978	Core
						CGS-118		K95631	Core
						CGS-119		K95982	Core
						CGS-120		K95633	Core
						76-DB-3	D184652	K69868	Channel
						76-DB-4	D188247		Parting
						76-DB-5	D184653	K69869	Channel
						76-DB-6	D184654	K69869	Channel
						76-DB-7	D188248		Floor
30			8	13S	90W	76-DJ-15	D184647	K69866	Channel
						76-DJ-16	D184648	K69866	Channel
						76-DJ-17	D184649	K69866	Channel
						76-DJ-18	D188249		Roof

Figure F6. (cont.)

UINTA REGION
CARBONDALE FIELD

PITKIN COUNTY

SAMPLE NUMBERS: 77-DJ-18,19,20

COAL BED NAME: Coal Basin "B"

GEOLOGIC ROCK UNIT: Williams Fork Fm.

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: 15 Meters: 4.6

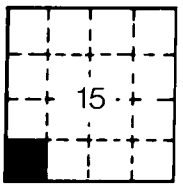
OVERBURDEN AT SAMPLING POINT:
Feet: 2000 Meters: 610

STRIKE: N 80°W

DIP: 15°SW

MAJOR CLEAT ORIENTATION IN COAL:
N 10°E
N 38°W, 90°

LOCATION IN SECTION



SECTION: 15

TOWNSHIP: 10 S

RANGE: 89 W

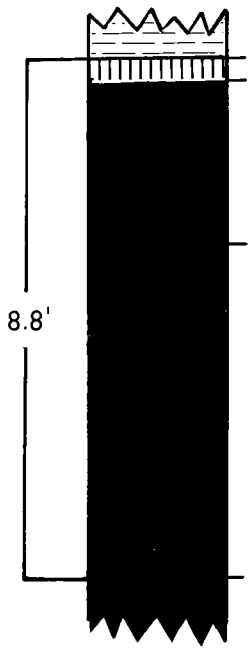
USGS TOPOGRAPHIC QUADRANGLE:
Placita 7.5' (1963)

MINE NAME: Coal Basin

MINE TYPE: Underground

OPERATOR/OWNER: Mid-Continent Coal & Coke Co.

COAL BASIN "B" COAL BED



SHALE: dark gray to black.

0.5' SHALY COAL: Sample No. 77-DJ-20, reddish brown.

2.8' COAL: Sample No. 77-DJ-19, abundant vitrain bands in bright attritus, sheared.

5.5' COAL: Sample No. 77-DJ-18, as above.

COAL: Not sampled.

SAMPLE NUMBER: 77-DJ-18

ANALYSES LABORATORY NUMBERS
USBM/DOE: K84727
USGS: D196222

APPARENT RANK OF COAL:
Medium-volatile bituminous

THICKNESS OF COAL:
Feet: 20 Meters: 6.1

THICKNESS SAMPLED:
Feet: 5.5 Meters: 1.7

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: 77-DJ-19

ANALYSES LABORATORY NUMBERS
USBM/DOE: K84726
USGS: D196221

APPARENT RANK OF COAL:
Medium-volatile bituminous

THICKNESS OF COAL:
Feet: 20 Meters: 6.1

THICKNESS SAMPLED:
Feet: 2.8 Meters: 0.85

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: 77-DJ-20

ANALYSES LABORATORY NUMBERS
USBM/DOE: --
USGS: D196438

APPARENT RANK OF COAL:
--

THICKNESS OF COAL:
Feet: 20 Meters: 6.1

THICKNESS SAMPLED:
Feet: 0.5 Meters: 0.15

TYPE OF SAMPLE: Shaly coal

JINTA REGION
CARBONDALE FIELD

PITKIN COUNTY

SAMPLE NUMBERS: 76-DJ-19,20

COAL BED NAME: "B"

GEOLOGIC ROCK UNIT: Lower Mesaverde Fm

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: 6.4 Meters: 2

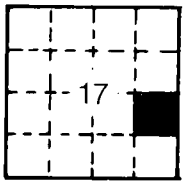
OVERBURDEN AT SAMPLING POINT:
Feet: 100-2500 Meters: 30-760

STRIKE: N - NE

DIP: 13°NW

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 17

TOWNSHIP: 10 S

RANGE: 89 W

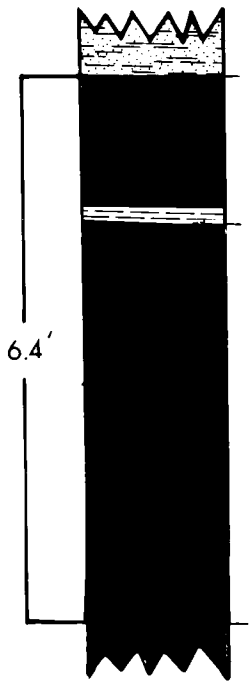
USGS TOPOGRAPHIC QUADRANGLE:
Placita 7.5' (1963)

MINE NAME: Dutch Creek No. 1

MINE TYPE: Underground

OPERATOR/OWNER: Midcontinent Coal & Coke Co.

"B" COAL BED



INTERBEDDED SHALE, SANDSTONE

3.2' COAL: Sample No. 76-DJ-19, banded, abundant vitrain in medium bright attritus, 0.5" gray shale parting 0.9' below upper contact.

3.2' COAL Sample No. 76-DJ-20, as above.

COAL Not sampled (unexposed).

SAMPLE NUMBER: 76-DJ-19

ANALYSES LABORATORY NUMBERS
USBM/DOE: K69860
USGS: D184637

APPARENT RANK OF COAL:
Medium-volatile bituminous

THICKNESS OF COAL:
Feet: 6.4 Meters: 2.0

THICKNESS SAMPLED:
Feet: 3.2 Meters: 1.0

TYPE OF SAMPLE: Upper coal-channel

SAMPLE NUMBER: 76-DJ-20

ANALYSES LABORATORY NUMBERS
USBM/DOE: K69860
USGS: D184638

APPARENT RANK OF COAL:
Medium-volatile bituminous

THICKNESS OF COAL:
Feet: 6.4 Meters: 2.0

THICKNESS SAMPLED:
Feet: 3.2 Meters: 1.0

TYPE OF SAMPLE: Lower coal-channel

PITKIN COUNTY

SAMPLE NUMBERS: 77-DJ-15,16,17

COAL BED NAME: Dutch Creek

GEOLOGIC ROCK UNIT: Williams Fork Fm

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: 7.15 Meters: 2.2

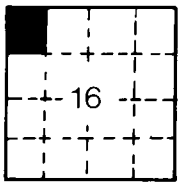
OVERBURDEN AT SAMPLING POINT:
Feet: 1500 Meters: 457

STRIKE: N 40°W

DIP: 15°SW

MAJOR CLEAT ORIENTATION IN COAL:
N 85°W - vertical
N 10°W - vertical

LOCATION IN SECTION



SECTION: 16

TOWNSHIP: 10 S

RANGE: 89 W

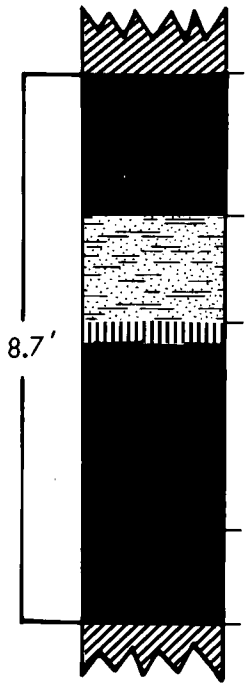
USGS TOPOGRAPHIC QUADRANGLE:
Placita 7.5' (1963)

MINE NAME: Dutch Creek No. 2

MINE TYPE: Underground

OPERATOR/OWNER: Mid-Continent Coal & Coke Co.

DUTCH CREEK COAL BED



SHALE: dark gray, fissle.

2.4' COAL: Sample No. 77-DJ-15, abundant thick vitrain bands in bright attritus.

1.5' SANDSTONE: Sample No. 77-DJ-16, gray, very hard, silty.

2.75' COAL: Sample No. 77-DJ-17, as above, upper 0.5' shaly, trace calcite.

1.5' COAL: Not sampled.

SAMPLE NUMBER: 77-DJ-15

ANALYSES LABORATORY NUMBERS
USBM/DOE: K84724
USGS: D196219

APPARENT RANK OF COAL:
Medium-volatile bituminous

THICKNESS OF COAL:
Feet: 8.7 Meters: 2.7

THICKNESS SAMPLED:
Feet: 2.4 Meters: 0.7

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: 77-DJ-16

ANALYSES LABORATORY NUMBERS
USBM/DOE: --
USGS: D196437

APPARENT RANK OF COAL:
--

THICKNESS OF COAL:
Feet: 8.7 Meters: 2.7

THICKNESS SAMPLED:
Feet: 1.5 Meters: 0.5

TYPE OF SAMPLE: Parting

SAMPLE NUMBER: 77-DJ-17

ANALYSES LABORATORY NUMBERS
USBM/DOE: K84725
USGS: D196220

APPARENT RANK OF COAL:
Medium-volatile bituminous

THICKNESS OF COAL:
Feet: 8.7 Meters: 2.7

THICKNESS SAMPLED:
Feet: 2.75 Meters: 0.84

TYPE OF SAMPLE: Coal-channel

UINTA REGION
CARBONDALE FIELD

GARFIELD COUNTY

SAMPLE NUMBER: 76-DJ-7

COAL BED NAME: A, C, & D (uncorrelated)

GEOLOGIC ROCK UNIT: Lower Mesaverde Group

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: -- Meters: --

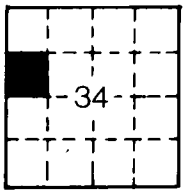
OVERBURDEN AT SAMPLING POINT:
Feet: -- Meters: --

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 34

TOWNSHIP: 7 S

RANGE: 89 W

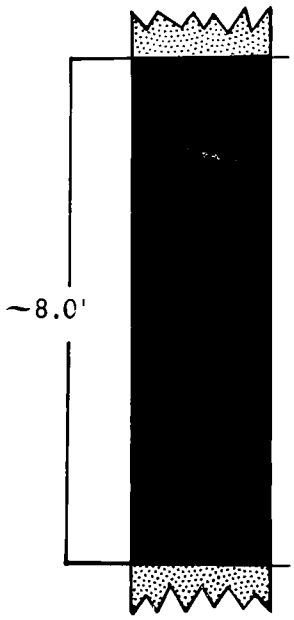
USGS TOPOGRAPHIC QUADRANGLE:
Cattle Creek 7.5' (1961)

MINE NAME: Sunlight

MINE TYPE: Underground

OPERATOR/OWNER: Carbon King Ltd.

"A", "C" or "D" COAL BED



SANDSTONE

COAL: Sample No. 76-DJ-7, medium to thick vitrain bands and some fusain in attritus, occasional irridescent haloes on fracture surface.

SANDSTONE

ANALYSES LABORATORY NUMBERS
USBM/DOE: K69859
USGS: D184636

APPARENT RANK OF COAL:
High-volatile B bituminous

THICKNESS OF COAL:
Feet: 8.0 (?) Meters: 2.5

THICKNESS SAMPLED:
Feet: -- Meters: --

TYPE OF SAMPLE: Coal-tipple

UINTA REGION
CARBONDALE FIELD

PITKIN COUNTY

SAMPLE NUMBERS: 78-CGS-20,21,22

COAL BED NAME: "A"

GEOLOGIC ROCK UNIT: Williams Fork Fm.

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: 6.3 Meters: 1.9

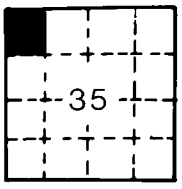
OVERBURDEN AT SAMPLING POINT:
Feet: 900 Meters: 27

STRIKE: N 3°E

DIP: 31°

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 35

TOWNSHIP: 8 S

RANGE: 89 W

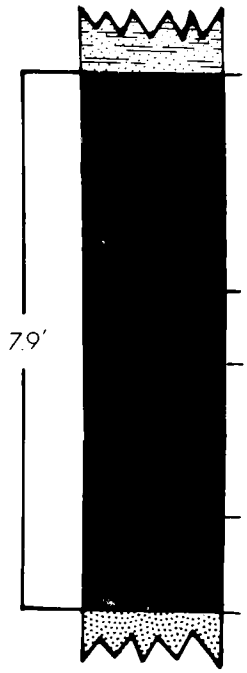
USGS TOPOGRAPHIC QUADRANGLE:
Stony Ridge 7.5' (1963)

MINE NAME: Thompson Creek No. 1

MINE TYPE: Underground

OPERATOR/OWNER: Western Associated Coal Corp.

"A" COAL BED



SHALY SILTSTONE: gray, sparse vitrain bands, sharp irregular basal contact.

3.1' COAL: Sample No. 78-CGS-22, abundant vitrain in bright attritus, discontinuous 0.1' shale parting 1.3' below upper contact.

0.9' COAL: Sample No. 78-CGS-21, vitrain in dull to bright attritus, some shaly areas.

2.4' COAL: Sample No. 78-CGS-20, vitrain in bright attritus.

1.5' COAL: Not sampled.

SANDSTONE: salt and pepper appearance, fine grained.

SAMPLE NUMBER: 78-CGS-20

ANALYSES LABORATORY NUMBERS
USBM/DOE: K92112
USGS: D208589

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 7.9 Meters: 2.4

THICKNESS SAMPLED:
Feet: 2.4 Meters: 0.72

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: 78-CGS-21

ANALYSES LABORATORY NUMBERS
USBM/DOE: K92112
USGS: D208589

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 7.9 Meters: 2.4

THICKNESS SAMPLED:
Feet: 0.9 Meters: 0.27

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: 78-CGS-22

ANALYSES LABORATORY NUMBERS
USBM/DOE: K92112
USGS: D208589

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 7.9 Meters: 2.4

THICKNESS SAMPLED:
Feet: 3.1 Meters: 0.95

TYPE OF SAMPLE: Coal-channel

UINTA REGION
CARBONDALE FIELD

PITKIN COUNTY

SAMPLE NUMBERS: 78-CGS-23,24,25

COAL BED NAME: Upper Sunshine

GEOLOGIC ROCK UNIT: Williams Fork Fm

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: 10.2 Meters: 3.1

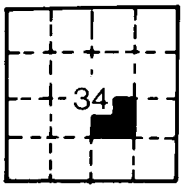
OVERBURDEN AT SAMPLING POINT:
Feet: 900 Meters: 274

STRIKE: N 3°E

DIP: 27°-33°W

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 34

TOWNSHIP: 8 S

RANGE: 89 W

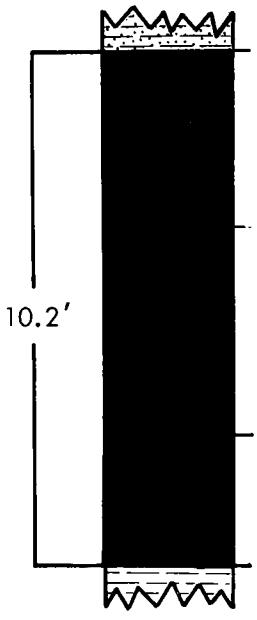
USGS TOPOGRAPHIC QUADRANGLE:
Stoney Ridge 7.5' (1963)

MINE NAME: Thompson Creek No. 3

MINE TYPE: Underground

OPERATOR/OWNER: Western Associated Coal Corp.

UPPER SUNSHINE COAL BED



SILTY SHALE: gray, sharp irregular basal contact.

3.5' COAL: Sample No. 78-CGS-25, vitrain in attritus, hard, blocky.

4.0' COAL: Sample No. 78-CGS-24, as above.

2.7' COAL: Sample No. 78-CGS-23, as above, water percolating through upper portion.

CARBONACEOUS SHALE: black, gradational contact.

SAMPLE NUMBER: 78-CGS-23

ANALYSES LABORATORY NUMBERS
USBM/DOE: K92113
USGS: D208590

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 10.2 Meters: 3.1

THICKNESS SAMPLED:
Feet: 2.7 Meters: .82

TYPE OF SAMPLE: Coal-channel

UINTA REGION
CARBONDALE FIELD

SAMPLE NUMBER: 78-CGS-24

ANALYSES LABORATORY NUMBERS
USBM/DOE: K92113
USGS: D208590

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 10.2 Meters: 3.1

THICKNESS SAMPLED:
Feet: 4.0 Meters: 1.2

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: 78-CGS-25

ANALYSES LABORATORY NUMBERS
USBM/DOE: K92113
USGS: D208590

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 10.2 Meters: 3.1

THICKNESS SAMPLED:
Feet: 3.5 Meters: 1.1

TYPE OF SAMPLE: Coal-channel

UINTA REGION
CARBONDALE FIELD

PITKIN COUNTY

SAMPLE NUMBER: 77-DJ-21

COAL BED NAME: Coal Basin "B"

GEOLOGIC ROCK UNIT: Williams Fork Fm.

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: -- Meters: --

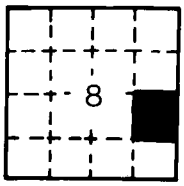
OVERBURDEN AT SAMPLING POINT:
Feet: 13-1500 Meters: 9.5-457

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 8

TOWNSHIP: 10 S

RANGE: 89 W

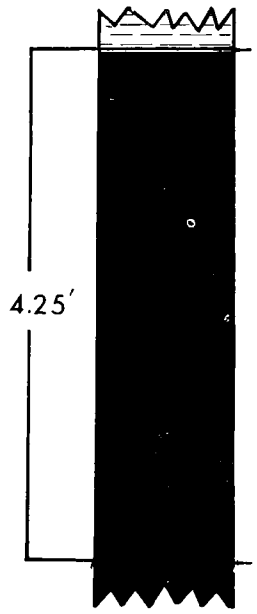
USGS TOPOGRAPHIC QUADRANGLE:
Placita 7.5' (1963)

MINE NAME: L. S. Wood

MINE TYPE: Underground

OPERATOR/OWNER: Mid-Continent Coal & Coke Co.

COAL BASIN "B" COAL BED



SHALE: dark gray, hard.

4.25' COAL: Sample No. 77-DJ-21, abundant thick vitrain bands in dull to bright attritus, very sheared.

19' COAL: Not sampled.

ANALYSES LABORATORY NUMBERS
USBM/DOE: K84728
USGS: D196223

APPARENT RANK OF COAL:
Medium-volatile bituminous

THICKNESS OF COAL:
Feet: 25 Meters: 7.6

THICKNESS SAMPLED:
Feet: 4.25 Meters: 1.3

TYPE OF SAMPLE: Coal-channel

UINTA REGION
CARBONDALE FIELD

MESA COUNTY

SAMPLE NUMBER: Vega-3 Core 2, Core 3

COAL BED NAME: Unnamed

GEOLOGIC ROCK UNIT: Mesaverde

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 26 Meters: 7.9

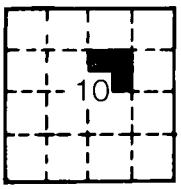
OVERBURDEN AT SAMPLING POINT:
Feet: 7587 Meters: 2313

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 10

TOWNSHIP: 10 S

RANGE: 93 W

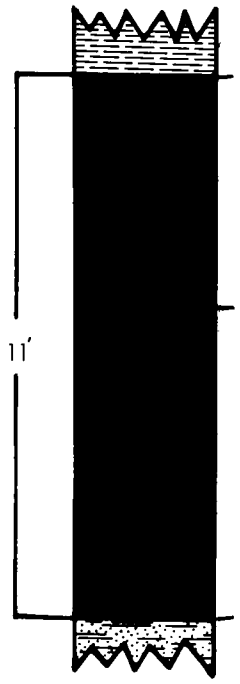
USGS TOPOGRAPHIC QUADRANGLE:
The Meadows 7.5' (1955)

DRILL HOLE: Exxon Vega-3

MINE TYPE: --

OPERATOR/OWNER: Exxon

COAL BED NAME UNKNOWN



SHALE: gray, hard, thin carbonaceous shale lenses.

5' COAL: Sample No. Vega 3 Core 2: blocky.

6' COAL: Sample No. Vega 3 Core 3: blocky.

SILTY SHALE

SAMPLE NUMBER: Vega-3 Core 2

ANALYSES LABORATORY NUMBERS
USBM/DOE: K99779
USGS: --

APPARENT RANK OF COAL:
Medium-volatile bituminous

THICKNESS OF COAL:
Feet: 11 Meters: 3.35

THICKNESS SAMPLED:
Feet: 5 Meters: 1.2

TYPE OF SAMPLE: Drill Core: Coal

UINTA REGION
CARBONDALE FIELD

SAMPLE NUMBER: Vega-3 Core 3

ANALYSES LABORATORY NUMBERS
USBM/DOE: K99780
USGS: --

APPARENT RANK OF COAL:
Low-volatile bituminous

THICKNESS OF COAL:
Feet: 11 Meters: 3.35

THICKNESS SAMPLED:
Feet: 6 Meters: 1.8

TYPE OF SAMPLE: Drill Core: Coal

UINTA REGION
CATHEDRAL GAS FIELD

RIO BLANCO COUNTY

SAMPLE NUMBER: 78-CGS-33

COAL BED NAME: Unknown

GEOLOGIC ROCK UNIT: Mesaverde

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 9.5 Meters: 2.9

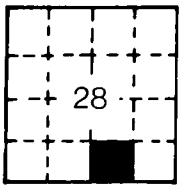
OVERBURDEN AT SAMPLING POINT:
Feet: 1603 Meters: 489

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 28

RANGE: 3 S

RANGE: 101 W

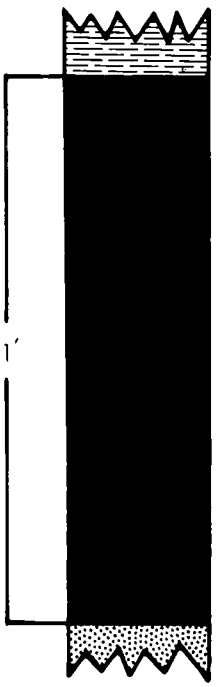
USGS TOPOGRAPHIC QUADRANGLE:
White Coyote Draw 7.5' (1964)

DRILL HOLE: 0-28-3-101-S

MINE TYPE: --

OPERATOR/OWNER: Fuelco

COAL BED NAME UNKNOWN



SHALE: dark gray, silty, sandstone stringers, vitrain bands at base.

COAL: Sample No. 78-CGS-23, blocky, crumbly, abundant thin to thick vitrain beds in attritus, conchoidal fracture.

SANDSTONE: light gray, fine grained, massive.

ANALYSES LABORATORY NUMBERS:
USBM/DOE: K90196
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 1 Meters: 0.3

THICKNESS SAMPLED:
Feet: 1 Meters: 0.3

TYPE OF SAMPLE: Drill Core: Coal

UINTA REGION
CATHEDRAL GAS FIELD

RIO BLANCO COUNTY

SAMPLE NUMBER: 78-CGS-29

COAL BED NAME: Unknown

GEOLOGIC ROCK UNIT: Mesaverde

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: 2.0 Meters: 0.6

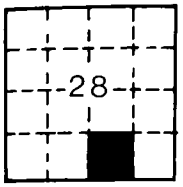
OVERBURDEN AT SAMPLING POINT:
Feet: 1583 Meters: 482.6

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 28

TOWNSHIP: 3 S

RANGE: 101 W

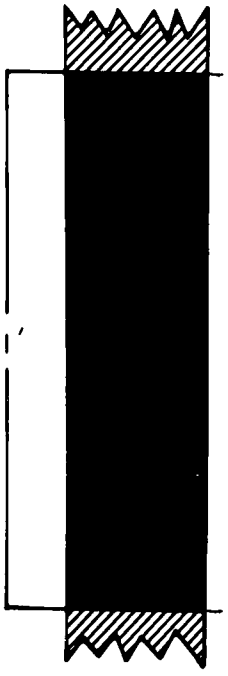
USGS TOPOGRAPHIC QUADRANGLE:
White Coyote Draw 7.5' (1964)

DRILL HOLE: 0-28-3-101-S

MINE TYPE: --

OPERATOR/OWNER: Fuelco

COAL BED NAME UNKNOWN



SHALE: dark gray, silty, sandstone lenses at top, vitrain bands at base.

COAL: Sample No. 78-CGS-19, blocky, crumbly, abundant thin to thick vitrain bands in attritus.

SANDSTONE: light gray, massive, fine grained.

ANALYSES LABORATORY NUMBERS
USBM/DOE: K90197
USGS: --

APPARENT RANK OF COAL:
High-volatile B bituminous

THICKNESS OF COAL:
Feet: 2 Meters: 0.6

THICKNESS SAMPLED:
Feet: 1 Meters: 0.3

TYPE OF SAMPLE: Drill Core: Coal

UINTA REGION
CATHEDRAL GAS FIELD

RIO BLANCO COUNTY

SAMPLE NUMBER: C & K 4-14 #27

COAL BED NAME: Unnamed

GEOLOGIC ROCK UNIT: Mesaverde Fm

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 53.9 Meters: 16.4

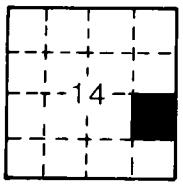
OVERBURDEN AT SAMPLING POINT:
Feet: 809.3 Meters: 246.7

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 14

TOWNSHIP: 3 S

RANGE: 101 W

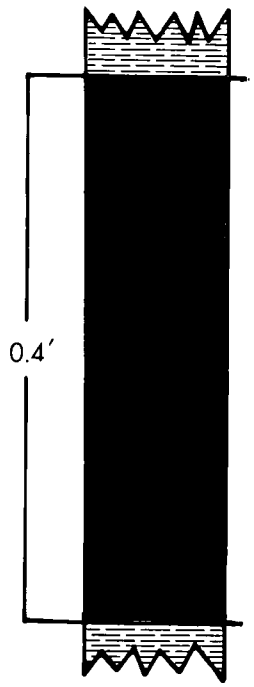
USGS TOPOGRAPHIC QUADRANGLE:
White Coyote Draw 7.5' (1964)

DRILL HOLE: C & K 4-14

MINE TYPE: --

OPERATOR/OWNER: Twin Arrow Inc.

COAL BED NAME UNKNOWN



CARBONACEOUS SHALE: grading to coal at base.

COAL: Sample No. C & K 4-14 #27, vitrain bands in attritus, resin, calcite and pyrite present.

CARBONACEOUS SHALE

ANALYSES LABORATORY NUMBERS
USBM/DOE: K92140
USGS: --

APPARENT RANK OF COAL:
High-volatile B bituminous

THICKNESS OF COAL:
Feet: 1.6 Meters: 0.5

THICKNESS SAMPLED:
Feet: 0.4 Meters: 0.1

TYPE OF SAMPLE: Drill Core: Coal

UINTA REGION
CATHEDRAL GAS FIELD

RIO BLANCO COUNTY

SAMPLE NUMBER: C & K 4-14 #29

COAL BED NAME: Unnamed

GEOLOGIC ROCK UNIT: Mesaverde Fm

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 25.5 Meters: 7.77

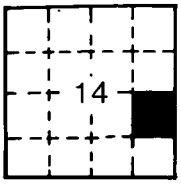
OVERBURDEN AT SAMPLING POINT:
Feet: 759 Meters: 231

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 14

TOWNSHIP: 3 S

RANGE: 101 W

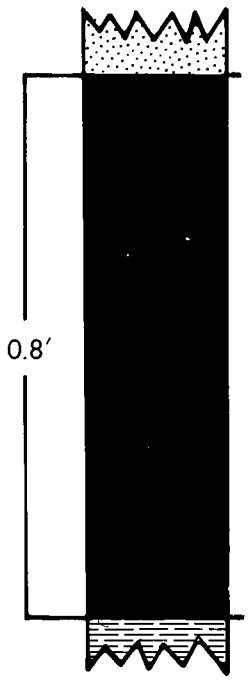
USGS TOPOGRAPHIC QUADRANGLE:
White Coyote Draw 7.5' (1969)

DRILL HOLE: C & K 4-14

MINE TYPE: --

OPERATOR/OWNER: Twin Arrow Inc.

COAL BED NAME UNKNOWN



SANDSTONE: massive, fine grained, some carbonaceous material.

COAL: Sample No. C & K 4-14 #29, vitrain bands in dull attritus.

CARBONACEOUS SHALE

ANALYSES LABORATORY NUMBERS
USBM/DOE: K92139
USGS: --

APPARENT RANK OF COAL:
High-volatile B bituminous

THICKNESS OF COAL:
Feet: 0.8 Meters: 0.2

THICKNESS SAMPLED:
Feet: 0.8 Meters: 0.2

TYPE OF SAMPLE: Drill Core: Coal

UINTA REGION
CATHEDRAL GAS FIELD

RIO BLANCO COUNTY

SAMPLE NUMBER: C & K 4-14 #38

COAL BED NAME: Unnamed

GEOLOGIC ROCK UNIT: Mesaverde

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 14.9 Meters: 4.54

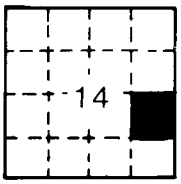
OVERBURDEN AT SAMPLING POINT:
Feet: 986.5 Meters: 300.8

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 14

TOWNSHIP: 3 S

RANGE: 101 W

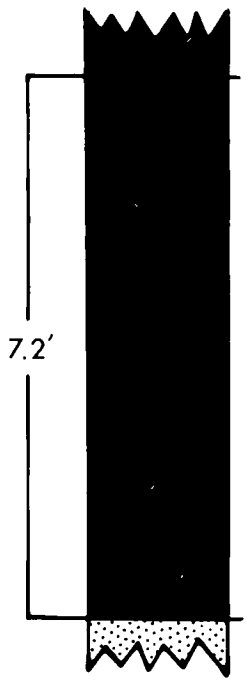
USGS TOPOGRAPHIC QUADRANGLE:
White Coyote Draw 7.5' (1964)

DRILL HOLE: C & K 4-14

MINE TYPE: --

OPERATOR/OWNER: Twin Arrow Inc.

COAL BED NAME UNKNOWN



COAL

COAL: Sample No. C & K 4-14 #38, banded, dominant vitrain.

SANDSTONE: light gray, fine grained, numerous carbonaceous stringers.

ANALYSES LABORATORY NUMBERS
USBM/DOE: K92143
USGS: --

APPARENT RANK OF COAL:
High-volatile B bituminous

THICKNESS OF COAL:
Feet: 7.2 Meters: 2.2

THICKNESS SAMPLED:
Feet: 0.8 Meters: 0.2

TYPE OF SAMPLE: Drill Core: Coal

UINTA REGION
CATHEDRAL GAS FIELD

RIO BLANCO COUNTY

SAMPLE NUMBERS: C & K 4-14 #36, #24

COAL BED NAME: Unnamed

GEOLOGIC ROCK UNIT: Mesaverde

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 4.8 Meters: 1.5

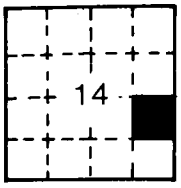
OVERBURDEN AT SAMPLING POINT:
Feet: 801.9 Meters: 243

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 14

TOWNSHIP: 3 S

RANGE: 101 W

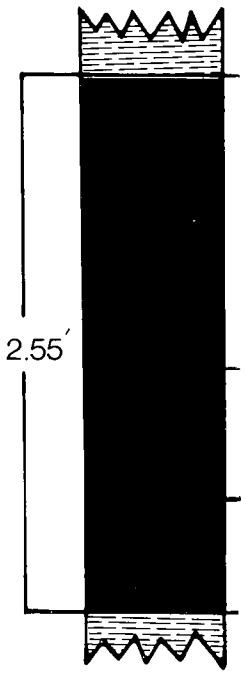
USGS TOPOGRAPHIC QUADRANGLE:
White Coyote Draw 7.5' (1964)

DRILL HOLE: C & K 4-14

MINE TYPE: --

OPERATOR/OWNER: Twin Arrow Inc.

COAL BED NAME UNKNOWN



CARBONACEOUS SHALE

1.3' COAL: Not sampled.

0.7' COAL: Sample No. C & K 4-14 #36, clean, thick v vitrain lenses, some pyrite, good cleavage in one direction.

0.55' COAL: Sample No. C & K 4-14 #24, as above.

CARBONACEOUS SHALE: Numerous vitrain lenses.

SAMPLE NUMBER: C & K 4-14 #36

ANALYSES LABORATORY NUMBERS
USBM/DOE: K92141
USGS: --

APPARENT RANK OF COAL:
High-volatile B bituminous

THICKNESS OF COAL:
Feet: 4.8 Meters: 1.5

THICKNESS SAMPLED:
Feet: 0.7 Meters: 0.2

TYPE OF SAMPLE: Drill Core: Coal

UINTA REGION
CATHEDRAL GAS FIELD

SAMPLE NUMBER: C & K 4-14, #24

ANALYSES LABORATORY NUMBERS
USBM/DOE: K92142
USGS: --

APPARENT RANK OF COAL:
High-volatile B bituminous

THICKNESS OF COAL:
Feet: 4.8 Meters: 1.5

THICKNESS SAMPLED:
Feet: 0.55 Meters: 0.17

TYPE OF SAMPLE: Drill Core: Coal

UINTA REGION
CRESTED BUTTE FIELD

GUNNISON COUNTY

SAMPLE NUMBER: 78-CGS-18

COAL BED NAME: Cheyenne

GEOLOGIC ROCK UNIT: Mesaverde Fm

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: -- Meters: --

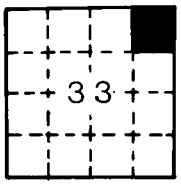
OVERBURDEN AT SAMPLING POINT:
Feet: -- Meters: --

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 33

TOWNSHIP: 13 S

RANGE: 86 W

USGS TOPOGRAPHIC QUADRANGLE:
Oh-Be Joyful 7.5' (1961)

MINE NAME: Horace

MINE TYPE: Underground

OPERATOR/OWNER: --

CHEYENNE COAL BED

COAL: Sample No. 78-CGS-18, grab sample from gob pile.

ANALYSES LABORATORY NUMBERS
USBM/DOE: K92110
USGS: D208587

APPARENT RANK OF COAL:
Semianthracite

THICKNESS OF COAL:
Feet: -- Meters: --

THICKNESS SAMPLED:
Feet: -- Meters: --

TYPE OF SAMPLE: Coal-grab

UINTA REGION
CRESTED BUTTE FIELD

GUNNISON COUNTY

SAMPLE NUMBER: 78-CGS-17

COAL BED NAME: "C" Kubler

GEOLOGIC ROCK UNIT: Mesaverde Fm

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: 5.6 Meters: 1.7

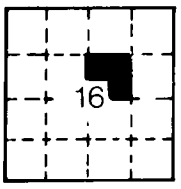
OVERBURDEN AT SAMPLING POINT:
Feet: 70 Meters: 21

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
N 63°W - Vertical
N 7°W

LOCATION IN SECTION



SECTION: 16

TOWNSHIP: 15 S

RANGE: 86 W

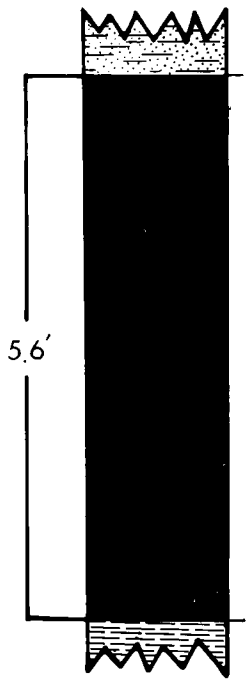
USGS TOPOGRAPHIC QUADRANGLE:
Squirrel Creek 7.5' (1965)

MINE NAME: O.C. No. 2

MINE TYPE: Underground

OPERATOR/OWNER: O.C. Mine Co.

"C" KUBLER COAL BED



SILTSTONE: gray, shaly, carbonized plant material, iron oxide stains, few sandstone lenses, contorted bedding, sharp irregular basal contact.

COAL: Sample No. 78-CGS-17, upper 2" shaly, hard concretions common.

CARBONACEOUS SHALE

ANALYSES LABORATORY NUMBERS
USBM/DOE: K92109
USGS: D208586

APPARENT RANK OF COAL:
High-volatile C bituminous

THICKNESS OF COAL:
Feet: 5.6 Meters: 1.7

THICKNESS SAMPLED:
Feet: 5.6 Meters: 1.7

TYPE OF SAMPLE: Coal-channel

UINTA REGION
CRESTED BUTTE FIELD

GUNNISON COUNTY

SAMPLE NUMBER: 78-CGS-19

COAL BED NAME: Unnamed

GEOLOGIC ROCK UNIT: Mesaverde Fm

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: -- Meters: --

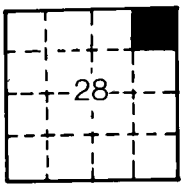
OVERBURDEN AT SAMPLING POINT:
Feet: -- Meters: --

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 28

TOWNSHIP: 13 S

RANGE: 86 W

USGS TOPOGRAPHIC QUADRANGLE:
Oh-be-Joyful 7.5' (1961)

MINE NAME: Peanut

MINE TYPE: Underground

OPERATOR/OWNER: --

COAL BED NAME UNKNOWN

COAL: Sample No. 78-CGS-19, grab sample from gob pile.

SAMPLE NUMBER: 78-CGS-19

ANALYSES LABORATORY NUMBERS
USBM/DOE: K92111
USGS: D208588

APPARENT RANK OF COAL:
Semianthracite

THICKNESS OF COAL:
Feet: -- Meters: --

THICKNESS SAMPLED:
Feet: -- Meters: --

TYPE OF SAMPLE: Coal-grab

UINTA REGION
DANFORTH HILLS FIELD

SAMPLE NUMBERS: - -

COAL BED NAME: Y3,Y2,X,A2,A3,B,C,D,E,F

GEOLOGIC ROCK UNIT: Williams Fork

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: 422 Meters: 129

OVERBURDEN AT SAMPLING POINT:
Feet: 33 Meters: 10

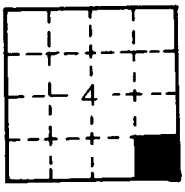
STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

MOFFAT COUNTY

LOCATION IN SECTION



SECTION: 4

TOWNSHIP: 3 N

RANGE: 93 W

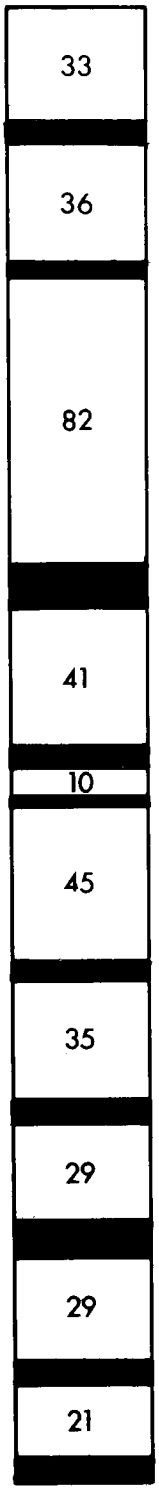
USGS TOPOGRAPHIC QUADRANGLE:
Axial 7.5' (1966)

MINE NAME: Colowyo Strip

MINE TYPE: Surface

OPERATOR/OWNER: Colowyo Coal Co.

Y3,Y2,X,A2,A3,B,C,D,E,
and F coal beds.



0-33'	INTERBEDDED SANDSTONE AND SILTSTONE
5.4'	COAL BED Y3
36'	Interbedded claystone, siltstone, and sandstone.
2.9'	COAL BED Y2
82'	SILTSTONE
12.9'	COAL BED X
41'	SILTSTONE
4.4'	COAL BED A2
10'	SANDSTONE
2.3'	COAL BED A3
45'	INTERBEDDED SANDSTONE, SILTSTONE, AND SHALE
5.9'	COAL BED B
35'	INTERBEDDED SILTSTONE AND SHALE
5.7'	COAL BED C
29'	SILTSTONE
9.6'	COAL BED D
29'	INTERBEDDED SILTSTONE AND SHALE
7.3'	COAL BED E
21'	INTERBEDDED SANDSTONE, SILTSTONE.
4.6'	COAL BED F

COMPLIMENTS OF COLOWYO COAL COMPANY

COAL BED: Y3

ANALYSES LABORATORY NUMBERS
USBM/DOE: --
USGS: --

APPARENT RANK OF COAL:
Subbituminous A

THICKNESS OF COAL:
Feet: 5.4 Meters: 1.7

THICKNESS SAMPLED:
Feet: 5.4 Meters: 1.7

TYPE OF SAMPLE: Drill Core: Coal

COAL BED: Y2

ANALYSES LABORATORY NUMBERS
USBM/DOE: --
USGS: --

APPARENT RANK OF COAL:
Subbituminous A

THICKNESS OF COAL:
Feet: 2.9 Meters: 0.9

THICKNESS SAMPLED:
Feet: 2.9 Meters: 0.9

TYPE OF SAMPLE: Drill Core: Coal

COAL BED: X

ANALYSES LABORATORY NUMBERS
USBM/DOE: --
USGS: --

APPARENT RANK OF COAL:
Subbituminous A

THICKNESS OF COAL:
Feet: 12.9 Meters: 3.9

THICKNESS SAMPLED:
Feet: 12.9 Meters: 3.9

TYPE OF SAMPLE: Drill Core: Coal

COAL BED: A2

ANALYSES LABORATORY NUMBERS:
USBM/DOE: --
USGS: --

APPARENT RANK OF COAL:
Subbituminous A

THICKNESS OF COAL:
Feet: 4.4 Meters: 1.3

THICKNESS SAMPLED:
Feet: 4.4 Meters: 1.3

TYPE OF SAMPLE: Drill Core: Coal

COAL BED: A3

ANALYSES LABORATORY NUMBERS
USBM/DOE: --
USGS: --

APPARENT RANK OF COAL:
Subbituminous A

THICKNESS OF COAL:
Feet: 2.3 Meters: 0.7

THICKNESS SAMPLED:
Feet: 2.3 Meters: 0.7

TYPE OF SAMPLE: Drill Core: Coal

COAL BED: B

ANALYSES LABORATORY NUMBERS:
USBM/DOE: --
USGS: --

APPARENT RANK OF COAL:
Subbituminous A

THICKNESS OF COAL:
Feet: 5.9 Meters: 1.8

THICKNESS SAMPLED:
Feet: 5.9 Meters: 1.8

TYPE OF SAMPLE: Drill Core: Coal

COAL BED: C

ANALYSES LABORATORY NUMBERS:
USBM/DOE: --
USGS: --

APPARENT RANK OF COAL:
Subbituminous A

THICKNESS OF COAL:
Feet: 5.7 Meters: 1.7

THICKNESS SAMPLED:
Feet: 5.7 Meters: 1.7

TYPE OF SAMPLE: Drill Core: Coal

COAL BED: D

ANALYSES LABORATORY NUMBERS
USBM/DOE: --
USGS: --

APPARENT RANK OF COAL:
High-volatile C bituminous

THICKNESS OF COAL:
Feet: 9.6 Meters: 2.9

THICKNESS SAMPLED:
Feet: 9.6 Meters: 2.9

TYPE OF SAMPLE: Drill Core: Coal

COAL BED: E

ANALYSES LABORATORY NUMBERS
USBM/DOE: --
USGS: --

APPARENT RANK OF COAL:
High-volatile C bituminous

THICKNESS OF COAL:
Feet: 7.3 Meters: 2.2

THICKNESS SAMPLED:
Feet: 7.3 Meters: 2.2

TYPE OF SAMPLE: Drill Core: Coal

COAL BED: F

ANALYSES LABORATORY NUMBERS
USBM/DOE: --
USGS: --

APPARENT RANK OF COAL:
High-volatile C bituminous

THICKNESS OF COAL:
Feet: 4.6 Meters: 1.4

THICKNESS SAMPLED:
Feet: 4.6 Meters: 1.4

TYPE OF SAMPLE: Drill Core: Coal

UINTA REGION
DANFORTH HILLS FIELD

RIO BLANCO COUNTY

SAMPLE NUMBER: 78-NBR-1

COAL BED NAME: Rienau #2

GEOLOGIC ROCK UNIT: Mesaverde

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: -- Meters: --

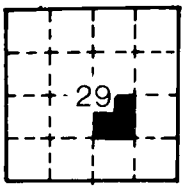
OVERBURDEN AT SAMPLING POINT:
Feet: 800 Meters: 244

STRIKE: NNE

DIP: 20°N

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 29

TOWNSHIP: 2 N

RANGE: 93 W

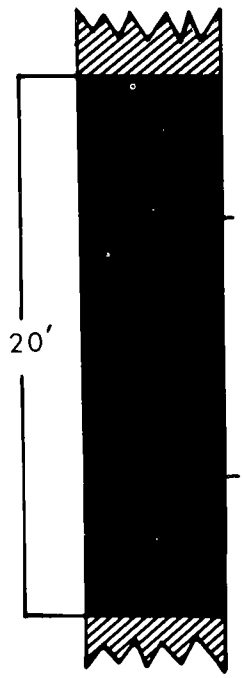
USGS TOPOGRAPHIC QUADRANGLE:
Rattlesnake Mesa 7.5' (1966)

MINE NAME: Rienau #2

MINE TYPE: Underground

OPERATOR/OWNER: Northern Coal Co.

RIENAU #2 COAL BED



5' COAL: Not sampled (not mined).

10' COAL: Sample No. 78-NBR-1, run of mines sample.

5' COAL: Not sampled (not mined).

ANALYSES LABORATORY NUMBERS
USBM/DOE: K92108
USGS: D208585

APPARENT RANK OF COAL:
High-volatile C bituminous

THICKNESS OF COAL:
Feet: 20 Meters: 6.1

THICKNESS SAMPLED:
Feet: 10 Meters: 3.1

TYPE OF SAMPLE: Run of mines

UINTA REGION
DANFORTH HILLS FIELD

RIO BLANCO COUNTY

SAMPLE NUMBER: CGS Core #1

COAL BED NAME: Upper D

GEOLOGIC ROCK UNIT: Williams Fork Fm.

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: 14 Meters: 4.2

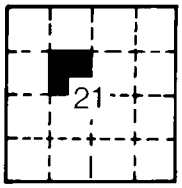
OVERBURDEN AT SAMPLING POINT:
Feet: 2124 Meters: 643.6

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 21

TOWNSHIP: 2 N

RANGE: 93 W

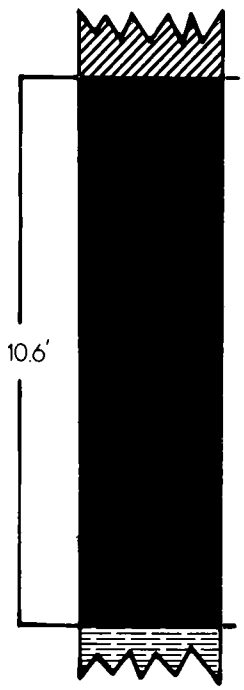
USGS TOPOGRAPHIC QUADRANGLE:
Ninemile Gap 7.5' (1966)

DRILL HOLE: 77-26C-NN

MINE TYPE: --

OPERATOR/OWNER: Northern Coal Co.

UPPER D COAL BED



SHALE

COAL: Sample No. CGS Core #1, hard, bright, blocky, conchoidal fracture.

SHALE

ANALYSES LABORATORY NUMBERS
USBM/DOE: K76536
USGS: --

APPARENT RANK OF COAL:
High-volatile C bituminous

THICKNESS OF COAL:
Feet: 10.6 Meters: 3.2

THICKNESS SAMPLED:
Feet: 10.6 Meters: 3.2

TYPE OF SAMPLE: Drill Core: Coal

UINTA REGION
DANFORTH HILLS

MOFFAT COUNTY

SAMPLE NUMBERS: D-38-EG Run 1,Run 2,Run 3

COAL BED NAME: Unknown

GEOLOGIC ROCK UNIT: Williams Fork Fm

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 38.7 Meters: 11.8

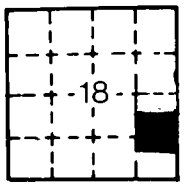
OVERBURDEN AT SAMPLING POINT:
Feet: 146.5 Meters: 44.7

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 18

TOWNSHIP: 4 N

RANGE: 94 W

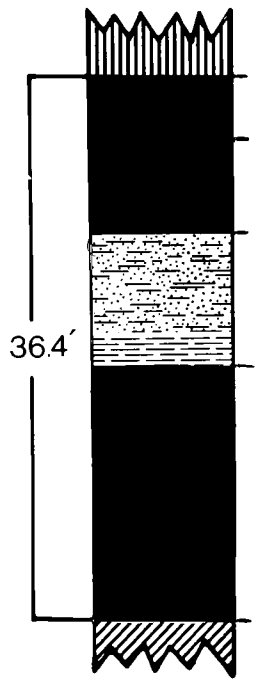
USGS TOPOGRAPHIC QUADRANGLE:
Easton Gulch 7.5' (1966)

DRILL HOLE: USGS-D-38-EG

MINE TYPE: --

OPERATOR/OWNER: USGS Conservation Divi

COAL BED NAME UNKNOWN



SHALY COAL: parting at base.

3.7' COAL: Sample No. D-38-EG Run 1, thin vitrain bands in bright attritus, trace pyrite.

6.9' COAL: Sample No. D-38-EG-Run 2, as above.

8.3' INTERBEDDED CARBONACEOUS SHALE, SILTSTONE AND SHALE.

17.5' COAL: Sample No. D-38-EG Run 3, moderate thin to medium vitrain bands in moderately bright attritus, some pyrite.

SAMPLE NUMBER: D-38-EG Run 1

ANALYSES LABORATORY NUMBERS
USBM/DOE: K89044
USGS: --

APPARENT RANK OF COAL:
High-volatile C bituminous

THICKNESS OF COAL:
Feet: 10.6 Meters: 3.2

THICKNESS SAMPLED:
Feet: 3.7 Meters: 1.13

TYPE OF SAMPLE: Drill Core: Coal

SAMPLE NUMBER: D-38-EG Run 2

ANALYSES LABORATORY NUMBERS
USBM/DOE: K89045
USGS: --

APPARENT RANK OF COAL:
High-volatile C bituminous

THICKNESS OF COAL:
Feet: 10.6 Meters: 3.2

THICKNESS SAMPLED:
Feet: 6.9 Meters: 2.1

TYPE OF SAMPLE: Drill Core: Coal

SAMPLE NUMBER: D-38-EG Run 3

ANALYSES LABORATORY NUMBERS
USBM/DOE: K89041
USGS: --

APPARENT RANK OF COAL:
High-volatile C bituminous

THICKNESS OF COAL:
Feet: 17.5 Meters: 5.3

THICKNESS SAMPLED:
Feet: 17.5 Meters: 5.3

TYPE OF SAMPLE: Drill Core: Coal

UINTA REGION
DANFORTH HILLS FIELD

MOFFAT COUNTY

SAMPLE NUMBERS: D-38-EG Run 4,Run 5

COAL BED NAME: Unknown

GEOLOGIC ROCK UNIT: Williams Fork Fm

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 26 Meters: 7.9

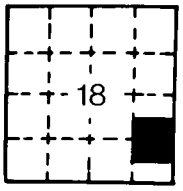
OVERBURDEN AT SAMPLING POINT:
Feet: 287.5 Meters: 87.6

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 18

TOWNSHIP: 4 N

RANGE: 94 W

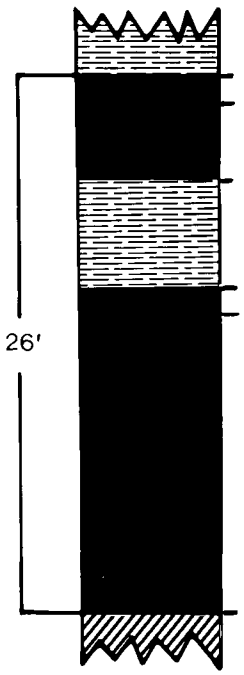
USGS TOPOGRAPHIC QUADRANGLE:
Easton Gulch 7.5' (1966)

DRILL HOLE: USGS D- 38-EG

MINE TYPE: --

OPERATOR/OWNER: USGS Conservation Divi

COAL BED NAME UNKNOWN



CARBONACEOUS SHALE

1.0' COAL: Sample No. D-38-EG Run 4, moderate thin to thick vitrain bands in attritus.

3.3' COAL: as above, not sampled.

5.1' CARBONACEOUS SHALE

1.1' COAL: Sample No. D-38-EG Run 5, hard, dominant vitrain, conchoidal fracture.

15.5' COAL: as above, not sampled.

SAMPLE NUMBER: D-38-EG Run 4

ANALYSES LABORATORY NUMBERS
USBM/DOE: K89043
USGS: --

APPARENT RANK OF COAL:
High-volatile C bituminous

THICKNESS OF COAL:
Feet: 4.3 Meters: 1.3

THICKNESS SAMPLED:
Feet: 1 Meters: 0.3

TYPE OF SAMPLE: Drill Core: Coal

UINTA REGION
DANFORTH HILLS FIELD

SAMPLE NUMBER: D-38-EG Run 5

ANALYSES LABORATORY NUMBERS
USBM/DOE: K89046
USGS: --

APPARENT RANK OF COAL:
High-volatile C bituminous

THICKNESS OF COAL:
Feet: 16.6 Meters: 5.1

THICKNESS SAMPLED:
Feet: 1.1 Meters: 0.34

TYPE OF SAMPLE: Drill Core: Coal

UINTA REGION
GRAND HOGBACK FIELD

GARFIELD COUNTY

SAMPLE NUMBERS: 77-DJ-8,11,5,6,7

COAL BED NAME: "E"

GEOLOGIC ROCK UNIT: Mesaverde Group

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: 19 Meters: 5.8

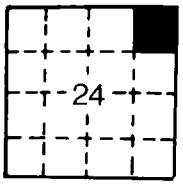
OVERBURDEN AT SAMPLING POINT:
Feet: 60 Meters: 18.3

STRIKE: N 80°E

DIP: 55°NW

MAJOR CLEAT ORIENTATION IN COAL:
--

LOCATION IN SECTION



SECTION: 24

TOWNSHIP: 5 S

RANGE: 92 W

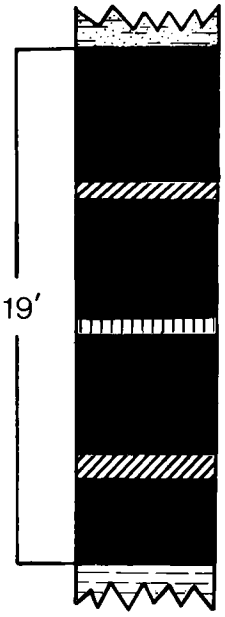
USGS TOPOGRAPHIC QUADRANGLE:
Silt 7.5' (1962)

MINE NAME: Eastside

MINE TYPE: Underground

OPERATOR/OWNER: Louis Bendetti Coal Co.

"E" COAL BED



SANDY SHALE: gray to black.

4.8' COAL: Sample No. 77-DJ-5, vitrain in bright attritus.

0.1' SHALE

4.8' COAL: Sample No. 77-DJ-6, as above.

0.5' CARBONACEOUS SHALE: Sample No. 77-DJ-7, brown to black, some coal lenses.

4.7' COAL: Sample No. 77-DJ-8, as above.

0.1' SHALE: light gray, some pyrite in fractures.

3.0' COAL: Sample No. 77-DJ-11, vitrain in dull to bright attritus, some shaly areas.

CARBONACEOUS SHALE: black, soft.

SAMPLE NUMBER: 77-DJ-8

ANALYSES LABORATORY NUMBERS
USBM/DOE: K84721
USGS: D196216

APPARENT RANK OF COAL:
High-volatile B bituminous

THICKNESS OF COAL:
Feet: 19 Meters: 5.8

THICKNESS SAMPLED:
Feet: 4.7 Meters: 1.4

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: 77-DJ-11

ANALYSES LABORATORY NUMBERS
USBM/DOE: K84722
USGS: D196217

APPARENT RANK OF COAL:
High-volatile B bituminous

THICKNESS OF COAL:
Feet: 19 Meters: 5.8

THICKNESS SAMPLED:
Feet: 3.0 Meters: 0.9

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: 77-DJ-5

ANALYSES LABORATORY NUMBERS
USBM/DOE: K84719
USGS: D196214

APPARENT RANK OF COAL:
High-volatile B bituminous

THICKNESS OF COAL:
Feet: 19 Meters: 5.8

THICKNESS SAMPLED:
Feet: 4.8 Meters: 1.5

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: 77-DJ-6

ANALYSES LABORATORY NUMBERS
USBM/DOE: K84720
USGS: D196215

APPARENT RANK OF COAL:
High-volatile B bituminous

THICKNESS OF COAL:
Feet: 19 Meters: 5.8

THICKNESS SAMPLED:
Feet: 4.8 Meters: 1.5

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: 77-DJ-7

ANALYSES LABORATORY NUMBERS
USBM/DOE: --
USGS: D196434

APPARENT RANK OF COAL:
--

THICKNESS OF COAL:
Feet: 19 Meters: 5.8

THICKNESS SAMPLED:
Feet: 0.5 Meters: 0.2

TYPE OF SAMPLE: Parting

UINTA REGION
GRAND HOGBACK FIELD

GARFIELD COUNTY

SAMPLE NUMBERS: 77-DJ-12,13,14

COAL BED NAME: Sunnyridge

GEOLOGIC ROCK UNIT: Mesaverde Group

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: 6.0 Meters: 1.8

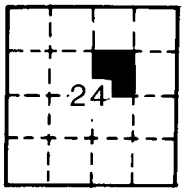
OVERBURDEN AT SAMPLING POINT:
Feet: 60-400 Meters: 18.3-122

STRIKE: N 90°W

DIP: 57°S

MAJOR CLEAT ORIENTATION IN COAL:
N 90°W - horizontal
N 0°W - 10°W

LOCATION IN SECTION



SECTION: 24

TOWNSHIP: 5 S

RANGE: 92 W

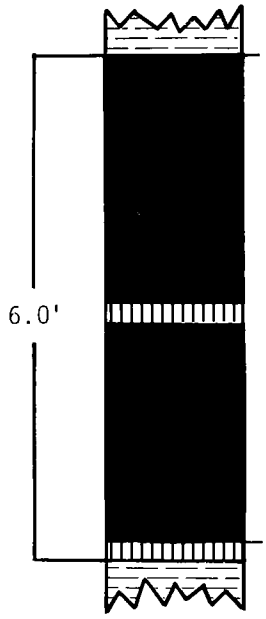
USGS TOPOGRAPHIC QUADRANGLE:
Silt 7.5' (1962)

MINE NAME: Nu-Gap No. 3

MINE TYPE: Underground

OPERATOR/OWNER: Henry Bendetti

SUNNYRIDGE COAL BED



SHALE Sample No. 77-DJ-13, gray, hard, few thin coal stringers.

COAL: Sample No. 77-DJ-12, vitrain in bright attritus, hard, 2" of shaly coal 3.0' below upper contact.

CARBONACEOUS SHALE: Sample No. 77-DJ-14, gray, hard, 3" of shaly coal at top.

SAMPLE NUMBER: 77-DJ-12

ANALYSES LABORATORY NUMBERS
USBM/DOE: K84723
USGS: D196218

APPARENT RANK OF COAL:
High-volatile B bituminous

THICKNESS OF COAL:
Feet: 6.0 Meters: 1.8

THICKNESS SAMPLED:
Feet: 5.75 Meters: 1.75

TYPE OF SAMPLE: Coal-channel

UINTA REGION
GRAND HOGBACK FIELD

SAMPLE NUMBER: 77-DJ-13

ANALYSES LABORATORY NUMBERS
USBM/DOE: --
USGS: D196435

APPARENT RANK OF COAL:

THICKNESS OF COAL:
Feet: -- Meters: --

THICKNESS SAMPLED:
Feet: -- Meters: --

TYPE OF SAMPLE: Roof rock

SAMPLE NUMBER: 77-DJ-14

ANALYSES LABORATORY NUMBERS
USBM/DOE: --
USGS: D196436

APPARENT RANK OF COAL:

THICKNESS OF COAL:
Feet: -- Meters: --

THICKNESS SAMPLED:
Feet: -- Meters: --

TYPE OF SAMPLE: Floor rock

UINTA REGION
SOMERSET FIELD

GUNNISON COUNTY

SAMPLE NUMBER: 76-DB-1,2

COAL BED NAME: "C"

GEOLOGIC ROCK UNIT: Lower Mesaverde

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: 6.0 Meters: 1.8

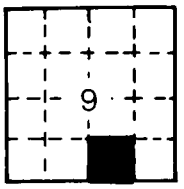
OVERBURDEN AT SAMPLING POINT:
Feet: 1400 Meters: 427

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
N 46°E, 90°

LOCATION IN SECTION



SECTION: 9

TOWNSHIP: 13 S

RANGE: 90 W

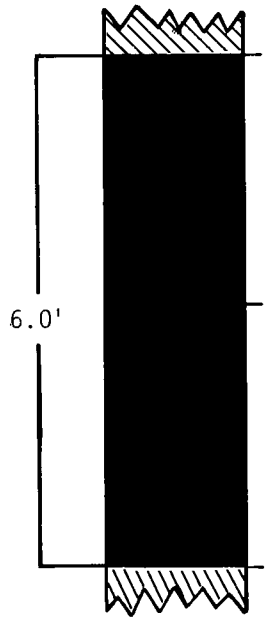
USGS TOPOGRAPHIC QUADRANGLE:
Somerset 7.5' (1964)

MINE NAME: Bear

MINE TYPE: Underground

OPERATOR/OWNER: Bear Coal Co.

"C" COAL BED



3.0' COAL: Sample No. 76-DB-1, thick vitrain bands in attritus with sparse fusain lenses.

3.0' COAL: Sample No. 76-DB-2, as above.

SAMPLE NUMBER: 76-DB-1

ANALYSES LABORATORY NUMBERS
USBM/DOE: K69867
USGS: D184650

APPARENT RANK OF COAL:
High-volatile B bituminous

THICKNESS OF COAL:
Feet: 6.0 Meters: 1.8

THICKNESS SAMPLED:
Feet: 3.0 Meters: 0.9

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: 76-DB-2

ANALYSES LABORATORY NUMBERS
USBM/DOE: K69867
USGS: D184651

APPARENT RANK OF COAL:
High-volatile B bituminous

THICKNESS OF COAL:
Feet: 6.0 Meters: 1.8

THICKNESS SAMPLED:
Feet: 3.0 Meters: 0.9

TYPE OF SAMPLE: Coal-channel

UINTA REGION
SOMERSET FIELD

GUNNISON COUNTY

SAMPLE NUMBERS: WSC #5 1A,1B,1C,78-SMG-103
78-SMG-102

COAL BED NAME: Wild

GEOLOGIC ROCK UNIT: Mesaverde

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 35.9 Meters: 10.9

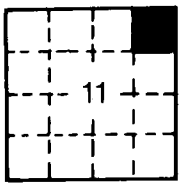
OVERBURDEN AT SAMPLING POINT:
Feet: 81.4 Meters: 24.8

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 11

TOWNSHIP: 13 S

RANGE: 90 W

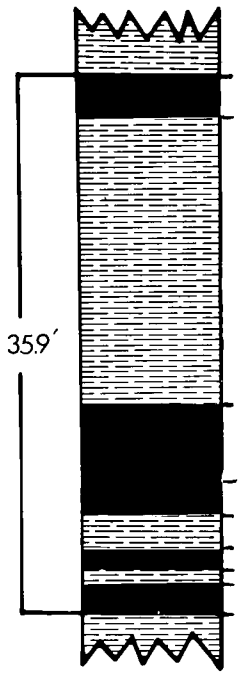
USGS TOPOGRAPHIC QUADRANGLE:
Somerset 7.5' (1964)

MINE NAME: Hawk's Nest East

DRILL HOLE: WSC #5

OPERATOR/OWNER: Western Slope Carbon

WILD COAL BED



SHALE: dark gray, hard, some carbonaceous plant material.

4.8' COAL: Sample No. WSC #5 1A, dominant fine vitrain bands in attritus, pyrite nodules, trace resin.

18.1' CARBONACEOUS SHALE:

4.4' COAL: Sample No. WSC #5 1B, varies from dominant vitrain to dominant attritus.

1.8' COAL: Sample No. 78-SMG-102, as above.

2.2' SHALE: dark gray to black.

1.6' COAL: Sample No. WSC #5 1C, attritus and vitrain.

1.3 SHALE: dark gray to black.

1.7' COAL: Sample No. 78-SMG-103, fine vitrain bands in attritus, shaly in places.

CARBONACEOUS SHALE

SAMPLE NUMBER: WSC #5 1A

ANALYSES LABORATORY NUMBERS
USBM/DOE: K92144
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 4.8 Meters: 1.4

THICKNESS SAMPLED:
Feet: 4.8 Meters: 1.4

TYPE OF SAMPLE: Drill Core: Coal

SAMPLE NUMBER: 78-SMG-102

ANALYSES LABORATORY NUMBERS
USBM/DOE: K99929
USGS: D216420

APPARENT RANK OF COAL:
High-volatile B bituminous

THICKNESS OF COAL:
Feet: 4.4 Meters: 1.3

THICKNESS SAMPLED:
Feet: 4.4 Meters: 1.3

TYPE OF SAMPLE: Drill Core: Coal

SAMPLE NUMBER: WSC #5 1B

ANALYSES LABORATORY NUMBER:
USBM/DOE: K94209
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 1.8 Meters: 0.5

THICKNESS SAMPLED:
Feet: 1.8 Meters: 0.5

TYPE OF SAMPLE: Drill Core: Coal

SAMPLE NUMBER: WSC #5 1C

ANALYSES LABORATORY NUMBERS:
USBM/DOE: K95626
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 1.6 Meters: 0.5

THICKNESS SAMPLED:
Feet: 1.6 Meters: 0.5

TYPE OF SAMPLE: Drill Core: Coal

SAMPLE NUMBER: 78-SMG-103

ANALYSES LABORATORY NUMBERS:
USBM/DOE: K99932
USGS: D216424

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 1.7 Meters: 0.5

THICKNESS SAMPLED:
Feet: 1.7 Meters: 0.5

TYPE OF SAMPLE: Drill Core: Coal

UINTA REGION
SOMERSET FIELD

GUNNISON COUNTY

SAMPLE NUMBERS: WSC #5 1D,78-SMG-106

COAL BED NAME: "D"

GEOLOGIC ROCK UNIT: Mesaverde-Bowie Member

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 16 Meters: 4.9

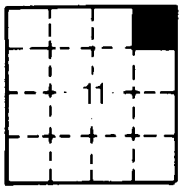
OVERBURDEN AT SAMPLING POINT:
Feet: 155.5 Meters: 47.4

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 11

TOWNSHIP: 13 S

RANGE: 90 W

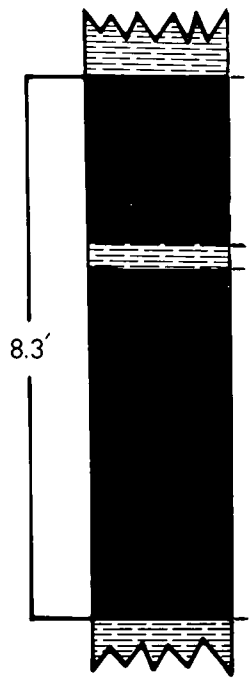
USGS TOPOGRAPHIC QUADRANGLE:
Somerset 7.5' (1964)

MINE NAME: Hawk's Nest East

DRILL HOLE: WSC #5

OPERATOR/OWNER: Western Slope Carbon

"D" COAL BED



CARBONACEOUS SHALE: abundant vitrain bands.

2.9' COAL: Sample No. WSC #5 1D, fine to medium vitrain bands in attritus, calcite in cleats, trace resin.

0.4' CARBONACEOUS SHALE: abundant fine vitrain bands.

5' COAL: Sample No. 78-SMG-106, moderate fine vitrain bands, rare medium bands in attritus, trace resin, shaly near bottom.

CARBONACEOUS SHALE: abundant fine vitrain bands.

SAMPLE NUMBER: WSC #5 1D

ANALYSES LABORATORY NUMBERS
USBM/DOE: K95630
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 2.9 Meters: 0.89

THICKNESS SAMPLED:
Feet: 2.9 Meters: 0.89

TYPE OF SAMPLE: Drill Core: Coal

UINTA REGION
SOMERSET FIELD

SAMPLE NUMBER: 78-SMG-106

ANALYSES LABORATORY NUMBERS
USBM/DOE: K99935
USGS: D216477

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 5 Meters: 1.5

THICKNESS SAMPLED:
Feet: 5 Meters: 1.5

TYPE OF SAMPLE: Drill Core: Coal

UINTA REGION
SOMERSET FIELD

GUNNISON COUNTY

SAMPLE NUMBERS: WSC #5 1E,1F,1H,1I,1J

COAL BED NAME: "C", "B"

GEOLOGIC ROCK UNIT: Mesaverde, Bowie Member

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 101.4 Meters: 30.9

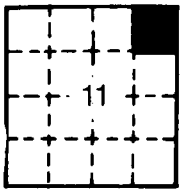
OVERBURDEN AT SAMPLING POINT:
Feet: 341.3 Meters: 104.1

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 11

TOWNSHIP: 13 S

RANGE: 90 W

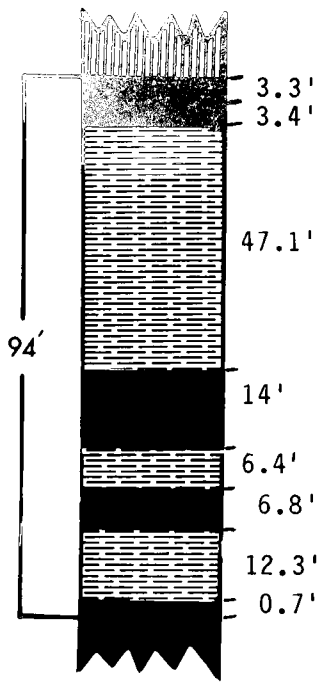
USGS TOPOGRAPHIC QUADRANGLE:
Somerset 7.5' (1964)

MINE NAME: Hawk's Nest East

DRILL HOLE: WSC #5

OPERATOR/OWNER: Western Slope Carbon

"C" AND "B" COAL BEDS



SHALY COAL

COAL: Sample Nos. WSC #5 1E,1F: banded, dominant vitrain in bright attritus, some resin and pyrite filled fractures, well formed cleat orientation.

CARBONACEOUS SHALE: dark gray, thin vitrain streaks.

COAL: Sample No. WSC #5 1H, moderate to abundant vitrain in attritus, rare resin.

CARBONACEOUS SHALE

COAL: Sample No. WSC #5 1-I, thin to thick vitrain bands in attritus, trace resin and gypsum.

CARBONACEOUS SHALE: dark gray.

COAL: Sample No. WSC #5 1-J, fine to thick vitrain lenses in dominant attritus.

COAL: Not sampled, as above.

SAMPLE NUMBER: WSC #5 1E

ANALYSES LABORATORY NUMBERS
USBM/DOE: K92145
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 6.7 Meters: 2.0

THICKNESS SAMPLED:
Feet: 3.3 Meters: 1.0

TYPE OF SAMPLE: Drill Core: Coal

SAMPLE NUMBER: WSC #5 1F

ANALYSES LABORATORY NUMBERS
USBM/DOE: D95971
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 6.7 Meters: 2.0

THICKNESS SAMPLED:
Feet: 3.4 Meters: 1.0

TYPE OF SAMPLE: Drill Core: Coal

SAMPLE NUMBER: WSC #5, 1H

ANALYSES LABORATORY NUMBERS
USBM/DOE: K95973
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 14 Meters: 4.3

THICKNESS SAMPLED:
Feet: 14 Meters: 4.3

TYPE OF SAMPLE: Drill Core: Coal

SAMPLE NUMBER: WSC #5, 1I

ANALYSES LABORATORY NUMBERS
USBM/DOE: K95974
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 6.8 Meters: 2.1

THICKNESS SAMPLED:
Feet: 4.6 Meters: 1.4

TYPE OF SAMPLE: Drill Core: Coal

SAMPLE NUMBER: WSC #5, 1J

ANALYSES LABORATORY NUMBERS
USBM/DOE: K94210
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 1.2 Meters: 0.4

THICKNESS SAMPLED:
Feet: 0.7 Meters: 0.2

TYPE OF SAMPLE: Drill Core: Coal

UINTA REGION
SOMERSET FIELD

GUNNISON COUNTY

SAMPLE NUMBERS: CGS-106,107

COAL BED NAME: "B"

GEOLOGIC ROCK UNIT: Mesaverde-Bowie Member

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 7.4 Meters: 2.3

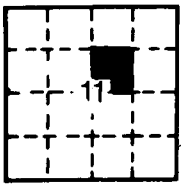
OVERBURDEN AT SAMPLING POINT:
Feet: 399.6 Meters: 121.8

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 11

TOWNSHIP: 13 S

RANGE: 90 W

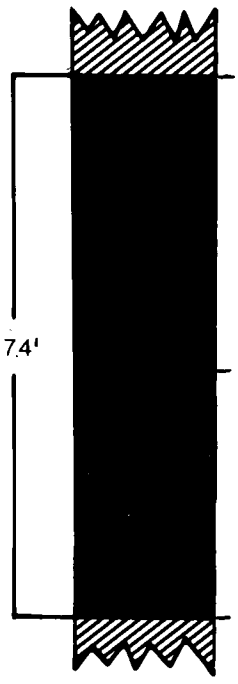
USGS TOPOGRAPHIC QUADRANGLE:
Somerset 7.5' (1969)

MINE NAME: Hawk's Nest East

DRILL HOLE: WSC #6

OPERATOR/OWNER: Western Slope Carbon

"B" COAL BED



2.4' COAL: Sample No. CGS 106, abundant fine vitrain bands, with a few thick vitrain lenses in dull attritus, good cleat development.

5.0' COAL: Sample No. CGS 107, moderate vitrain bands in bright to dull attritus, trace flake pyrite on cleats, well developed face cleat.

SAMPLE NUMBER: CGS-106

ANALYSES LABORATORY NUMBERS
USBM/DOE: K94211
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 2.4 Meters: 0.7

THICKNESS SAMPLED:
Feet: 7.4 Meters: 2.3

TYPE OF SAMPLE: Drill Core: Coal

UINTA REGION
SOMERSET FIELD

SAMPLE NUMBER: CGS-107

ANALYSES LABORATORY NUMBERS
USBM/DOE: K95632
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 7.4 Meters: 2.3

THICKNESS SAMPLED:
Feet: 5 Meters: 1.5

TYPE OF SAMPLE: Drill Core: Coal

UINTA REGION
SOMERSET FIELD

GUNNISON COUNTY

SAMPLE NUMBER: CGS-108

COAL BED NAME: "C" Seam

GEOLOGIC ROCK UNIT: Mesaverde-Bowie Member

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 4.6 Meters: 1.4

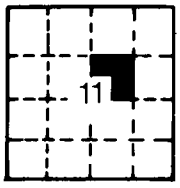
OVERBURDEN AT SAMPLING POINT:
Feet: 337.4 Meters: 102.9

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 11

TOWNSHIP: 13 S

RANGE: 90 W

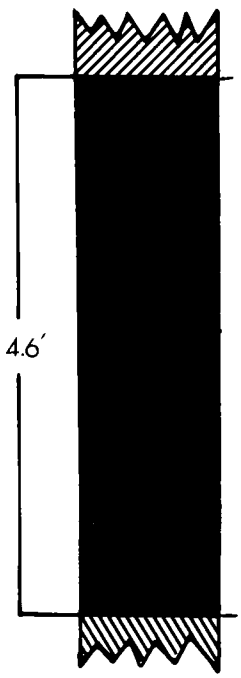
USGS TOPOGRAPHIC QUADRANGLE:
Somerset 7.5' (1964)

MINE NAME: Hawk's Nest East

DRILL HOLE: WSC #6

OPERATOR/OWNER: Western Slope Carbon

"C" COAL BED



COAL: Sample No. CGS-108, thin to medium vitrain bands in attritus, calcite in cleats, some resin, one good cleat direction.

SAMPLE NUMBER: CGS-108

ANALYSES LABORATORY NUMBERS
USBM/DOE: K95627
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 4.6 Meters: 1.4

THICKNESS SAMPLED:
Feet: 4.6 Meters: 1.4

TYPE OF SAMPLE: Drill Core: Coal

UINTA REGION
SOMERSET FIELD

GUNNISON COUNTY

SAMPLE NUMBER: CGS #109

COAL BED NAME: "C"

GEOLOGIC ROCK UNIT: Mesaverde-Bowie Member

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 2.9 Meters: 0.9

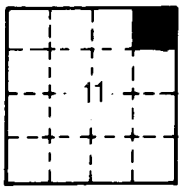
OVERBURDEN AT SAMPLING POINT:
Feet: 339 Meters: 103.4

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 11

TOWNSHIP: 13 S

RANGE: 90 W

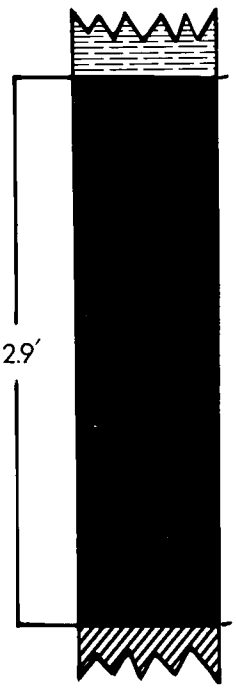
USGS TOPOGRAPHIC QUADRANGLE:
Somerset 7.5' (1964)

DRILL HOLE: Hawk's Nest East

DRILL HOLE: WSC #7

OPERATOR/OWNER: Western Slope Carbon

"C" COAL BED



CARBONACEOUS SHALE: vitrain bands, seed pods two inches above top of coal.

COAL: Sample No. CGS 109, thin to medium vitrain bands in attritus, resinous, rare gypsum on cleats, well developed cleat.

SAMPLE NUMBER: CGS-109

ANALYSES LABORATORY NUMBERS
USBM/DOE: K95977
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 2.9 Meters: 0.9

THICKNESS SAMPLED:
Feet: 2.9 Meters: 0.9

TYPE OF SAMPLE: Drill Core: Coal

UINTA REGION
SOMERSET FIELD

GUNNISON COUNTY

SAMPLE NUMBERS: CGS #110,#111

COAL BED NAME: "B"

GEOLOGIC ROCK UNIT: Mesaverde, Bowie Member

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 29.3 Meters: 8.9

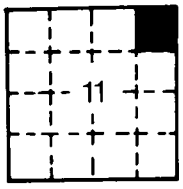
OVERBURDEN AT SAMPLING POINT:
Feet: 392.8 Meters: 119.7

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 11

TOWNSHIP: 13 S

RANGE: 90 W

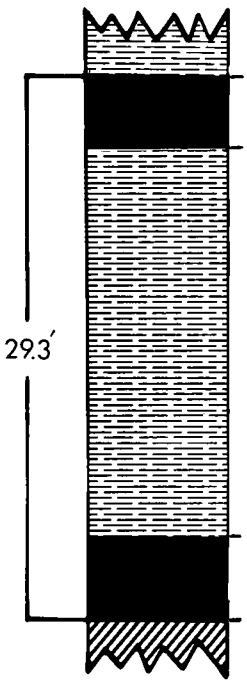
USGS TOPOGRAPHIC QUADRANGLE:
Somerset 7.5' (1964)

MINE NAME: Hawk's Nest East

DRILL HOLE: WSC #7

OPERATOR/OWNER: Western Slope Carbon

"B" COAL BED



CARBONACEOUS SHALE: dark gray, silty.

4.3' COAL: Sample No. CGS 110, fine to medium vitrain bands in attritus, calcite, some gypsum on cleats, well developed cleat.

20' CARBONACEOUS SHALE

5' COAL: Sample No. CGS 111, fine to thick vitrain bands in attritus, well developed cleat.

SAMPLE NUMBER: CGS-110

ANALYSES LABORATORY NUMBERS
USBM/DOE: K95975
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 4.3 Meters: 1.3

THICKNESS SAMPLED:
Feet: 4.3 Meters: 1.3

TYPE OF SAMPLE: Drill Core: Coal

UINTA REGION
SOMERSET FIELD

SAMPLE NUMBER: CGS #111

ANALYSES LABORATORY NUMBERS
USBM/DOE: K95976
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 5 Meters: 1.5

THICKNESS SAMPLED:
Feet: 5 Meters: 1.5

TYPE OF SAMPLE: Drill Core: Coal

UINTA REGION
SOMERSET FIELD

GUNNISON COUNTY

SAMPLE NUMBERS: CGS-112,113,114

COAL BED NAME: Wild Seam, "D"

GEOLOGIC ROCK UNIT: Mesaverde-Paonia Member

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 75 Meters: 23

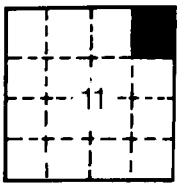
OVERBURDEN AT SAMPLING POINT:
Feet: 80.3 Meters: 24.5

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 11

TOWNSHIP: 13 S

RANGE: 90 W

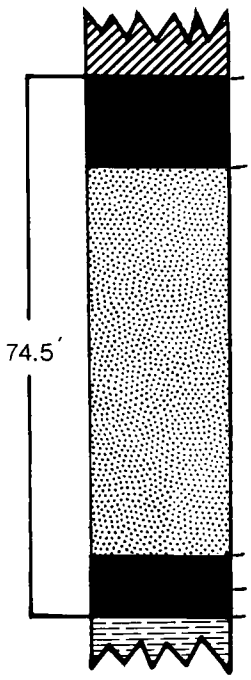
USGS TOPOGRAPHIC QUADRANGLE:
Somerset 7.5' (1964)

MINE NAME: Hawk's Nest East

DRILL HOLE: WSC #8

OPERATOR/OWNER: Western Slope Carbon

WILD, "D" COAL BED



12' COAL: Sample No. CGS 112, fine vitrain bands in attritus, resin and some pyrite on cleat faces, good cleat in one direction.

55.2' SANDSTONE: gray, medium grained, black carbonaceous shale at base.

4' COAL: Sample No. CGS 113, abundant vitrain bands in dull attritus.

3.3' COAL: Sample No. CGS 114, as above.
CARBONACEOUS SHALE

SAMPLE NUMBER: CGS-112

ANALYSES LABORATORY NUMBERS:
USBM/DOE: K95625
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 12 Meters: 3.6

THICKNESS SAMPLED:
Feet: 12 Meters: 3.6

TYPE OF SAMPLE: Drill Core: Coal

SAMPLE NUMBER: CGS-113

ANALYSES LABORATORY NUMBERS
USBM/DOE: K95628
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 7.3 Meters: 2.2

THICKNESS SAMPLED:
Feet: 4 Meters: 1.2

TYPE OF SAMPLE: Drill Core: Coal

SAMPLE NUMBER: CGS-114

ANALYSES LABORATORY NUMBERS:
USBM/DOE: K95629
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 7.3 Meters: 2.2

THICKNESS SAMPLED:
Feet: 3.3 Meters: 1.0

TYPE OF SAMPLE: Drill Core: Coal

UINTA REGION
SOMERSET FIELD

GUNNISON COUNTY

SAMPLE NUMBER: CGS-115,116

COAL BED NAME: "C" Seam

GEOLOGIC ROCK UNIT: Mesaverde, Bowie Member

GEOLOGIC AGE: Cretaceous

TOTAL SECTION MEASURED:
Feet: 10.4 Meters: 3.2

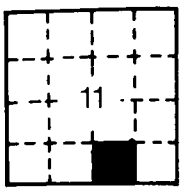
OVERBURDEN AT SAMPLING POINT:
Feet: 346 Meters: 105.7

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
-- --

LOCATION IN SECTION



SECTION: 11

TOWNSHIP: 13 S

RANGE: 90 W

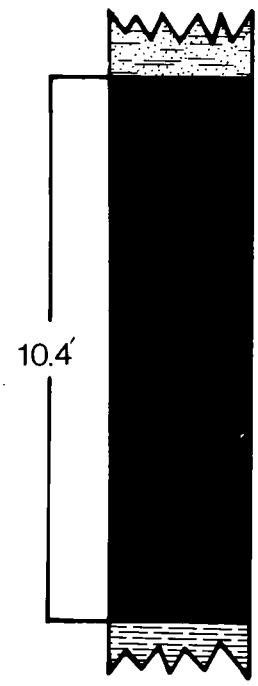
USGS TOPOGRAPHIC QUADRANGLE:
Somerset 7.5' (1964)

MINE NAME: Hawk's Nest East

DRILL HOLE: WSC #8

OPERATOR/OWNER: Western Slope Carbon

"C" COAL BED



INTERBEDDED SANDSTONE, SILTSTONE, AND SHALE

5.4' COAL: Sample No. CGS 115, fine vitrain bands in attritus, rare flake pyrite in cleats, moderately well developed cleat.

5' COAL: Sample No. CGS 116, as above.

CARBONACEOUS SHALE: brown to black with abundant fine vitrain bands.

SAMPLE NUMBER: CGS-115

ANALYSES LABORATORY NUMBERS:
USBM/DOE: K95983
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:"
Feet: 10.4 Meters: 3.2

THICKNESS SAMPLED:
Feet: 5.42 Meters: 1.65

TYPE OF SAMPLE: Drill Core: Coal

UINTA REGION
SOMERSET FIELD

SAMPLE NUMBER: CGS-116

ANALYSES LABORATORY NUMBERS:
USBM/DOE: --
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 10.4 Meters: 3.2

THICKNESS SAMPLED:
Feet: 5 Meters: 1.5

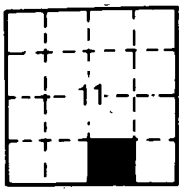
TYPE OF SAMPLE: Drill Core: Coal

UINTA REGION
SOMERSET FIELD

GUNNISON COUNTY

SAMPLE NUMBERS: CGS-117,118,119,120

LOCATION IN SECTION



COAL BED NAME: "B"

GEOLOGIC ROCK UNIT: Mesaverde-Bowie Member

SECTION: 11

GEOLOGIC AGE: Upper Cretaceous

TOWNSHIP: 13 S

TOTAL SECTION MEASURED:
Feet: 31 Meters: 4.48

RANGE: 90 W

USGS TOPOGRAPHIC QUADRANGLE:
Somerset 7.5' (1964)

OVERBURDEN AT SAMPLING POINT:
Feet: 393.8 Meters: 120.1

STRIKE: --

MINE NAME: Hawk's Nest East

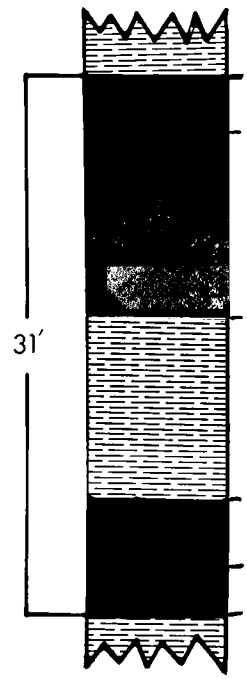
DIP: --

DRILL HOLE: WSC #8

MAJOR CLEAT ORIENTATION IN COAL:
-- --

OPERATOR/OWNER: Western Slope Carbon

"B" COAL BED



CARBONACEOUS SHALE: brown to black.

3.2' COAL: Sample No. CGS 117, fine to thick vitrain bands in attritus, some calcite on cleats, rare pyrite and resin, excellent cleat development.

11' COAL: Sample No. CGS 118, as above.

10.1' CARBONACEOUS SHALE: brownish black, contains sandstone and shale lenses.

3.9' COAL: Sample No. CGS 119, fine to medium vitrain bands in attritus, scarce mineralization.

2.8' COAL: Sample No. CGS 120, as above.

CARBONACEOUS SHALE: brown to black.

SAMPLE NUMBER: CGS-117

ANALYSES LABORATORY NUMBERS
USBM/DOE: K95978
USGS: --

THICKNESS OF COAL:
Feet: 14.2 Meters: 4.3

THICKNESS SAMPLED:
Feet: 3.2 Meters: 0.98

APPARENT RANK OF COAL:
High-volatile A bituminous

TYPE OF SAMPLE: Drill Core: Coal

SAMPLE NUMBER: CGS-118

ANALYSES LABORATORY NUMBERS
USBM/DOE: K95631
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:"
Feet: 14.2 Meters: 4.3

THICKNESS SAMPLED:
Feet: 11 Meters: 3.4

TYPE OF SAMPLE: Drill Core: Coal

SAMPLE NUMBER: CGS-119

ANALYSES LABORATORY NUMBERS:
USBM/DOE: K95982
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 6.7 Meters: 2.0

THICKNESS SAMPLED:
Feet: 3.9 Meters: 1.2

TYPE OF SAMPLE: Drill Core: Coal

SAMPLE NUMBER: CGS-120

ANALYSES LABORATORY NUMBERS
USBM/DOE: K95633
USGS: --

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 6.7 Meters: 2.0

THICKNESS SAMPLED:
Feet: 2.8 Meters: 0.86

TYPE OF SAMPLE: Drill Core: Coal

UINTA REGION
SOMERSET FIELD

GUNNISON COUNTY

SAMPLE NUMBERS: 76-DB-3,4,5,6,7

COAL BED NAME: "E"

GEOLOGIC ROCK UNIT: Mesaverde Group

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: 8.6 Meters: 2.6

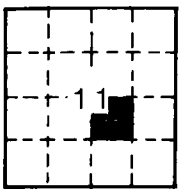
OVERBURDEN AT SAMPLING POINT:
Feet: 1600-2000 Meters: 488-610

STRIKE: --

DIP: --

MAJOR CLEAT ORIENTATION IN COAL:
N 50°E, 90°

LOCATION IN SECTION



SECTION: 11

TOWNSHIP: 13 S

RANGE: 90 W

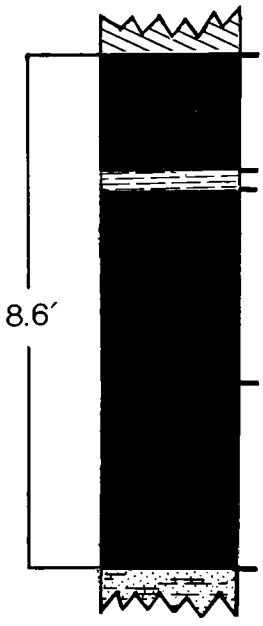
USGS TOPOGRAPHIC QUADRANGLE:
Somerset 7.5' (1964)

MINE NAME: Hawk's Nest #3

MINE TYPE: Underground

OPERATOR/OWNER: Western Slope Carbon, Inc.

"E" COAL BED



COAL: Not sampled.

2.5' COAL: Sample No. 76-DB-3, vitrain bands in attritus, sparse fusain lenses.

0.1' CARBONACEOUS SHALE: Sample No. 76-DB-4, dark brown.

3.0' COAL: Sample No. 76-DB-5, as above.

3.0' COAL: Sample No. 76-DB-6, as above.

SANDY SHALE: Sample No. 76-DB-7, brown.

SAMPLE NUMBER: 76-DB-3

ANALYSES LABORATORY NUMBERS
USBM/DOE: K69868
USGS: D184652

APPARENT RANK OF COAL:
High-volatile B bituminous

THICKNESS OF COAL:
Feet: 8.6 Meters: 2.6

THICKNESS SAMPLED:
Feet: 2.5 Meters: 0.8

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: 76-DB-4

ANALYSES LABORATORY NUMBERS
USBM/DOE: --
USGS: D188247

APPARENT RANK OF COAL:
--

THICKNESS OF COAL:
Feet: -- Meters: --

THICKNESS SAMPLED:
Feet: 0.08 Meters: 0.03

TYPE OF SAMPLE: Parting

SAMPLE NUMBER: 76-DB-5

ANALYSES LABORATORY NUMBERS
USBM/DOE: K69869
USGS: D184653

APPARENT RANK OF COAL:
High-volatile B bituminous

THICKNESS OF COAL:
Feet: 8.6 Meters: 2.6

THICKNESS SAMPLED:
Feet: 3.0 Meters: 0.9

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: 76-DB-6

ANALYSES LABORATORY NUMBERS
USBM/DOE: K69869
USGS: D184654

APPARENT RANK OF COAL:
High-volatile B bituminous

THICKNESS OF COAL:
Feet: 8.6 Meters: 2.6

THICKNESS SAMPLED:
Feet: 3.0 Meters: 0.9

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: 76-DB-7

ANALYSES LABORATORY NUMBERS
USBM/DOE: --
USGS: D188248

APPARENT RANK OF COAL:
--

THICKNESS OF COAL:
Feet: -- Meters: --

THICKNESS SAMPLED:
Feet: -- Meters: --

TYPE OF SAMPLE: Floor rock

UINTA REGION
SOMERSET FIELD

GUNNISON COUNTY

SAMPLE NUMBERS: 76-DJ-15,16,17,18

COAL BED NAME: "B"

GEOLOGIC ROCK UNIT: Mesaverde Group

GEOLOGIC AGE: Upper Cretaceous

TOTAL SECTION MEASURED:
Feet: 6.8 Meters: 2.1

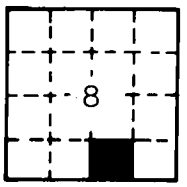
OVERBURDEN AT SAMPLING POINT:
Feet: 20-1200 Meters: 6-366

STRIKE: NW

DIP: 6°NE

MAJOR CLEAT ORIENTATION IN COAL:
N 29-49°E, 72-86°SE
N 45-55°W, 51-55°SW

LOCATION IN SECTION



SECTION: 8

TOWNSHIP: 13 S

RANGE: 90 W

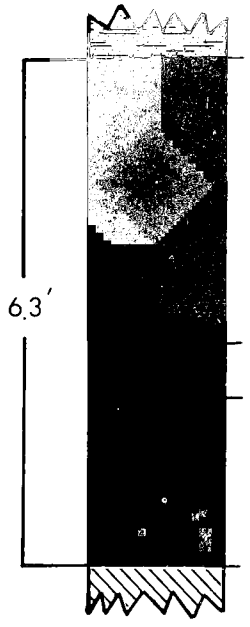
USGS TOPOGRAPHIC QUADRANGLE:
Somerset 7.5' (1964)

MINE NAME: Somerset

MINE TYPE: Underground

OPERATOR/OWNER: U.S. Steel Corp.

"B" COAL BED



SANDY SHALE: Sample No. 76-DJ-18, gray, very hard.

3.5' COAL: Sample No. 76-DJ-15, vitrain in attritus, trace pyrite.

0.5' COAL: Sample No. 76-DJ-16, thin vitrain stringers in attritus and fusain.

2.3' COAL: Sample No. 76-DJ-17, dominantly attritus with sparse vitrain bands becoming increasingly abundant toward top.

SAMPLE NUMBER: 76-DJ-15

ANALYSES LABORATORY NUMBERS
USBM/DOE: K69866
USGS: D184647

APPARENT RANK OF COAL:
High-volatile B bituminous

THICKNESS OF COAL:
Feet: 24-26 Meters: 7.3-7.9

THICKNESS SAMPLED:
Feet: 3.5 Meters: 1.1

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: 76-DJ-16

ANALYSES LABORATORY NUMBERS
USBM/DOE: K69866
USGS: D184648

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 24-26 Meters: 7.3-7.9

THICKNESS SAMPLED:
Feet: 0.5 Meters: 0.2

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: 76-DJ-17

ANALYSES LABORATORY NUMBERS
USBM/DOE: K69866
USGS: D184649

APPARENT RANK OF COAL:
High-volatile A bituminous

THICKNESS OF COAL:
Feet: 24-26 Meters: 7.3-7.9

THICKNESS SAMPLED:
Feet: 2.3 Meters: 0.7

TYPE OF SAMPLE: Coal-channel

SAMPLE NUMBER: 76-DJ-18

ANALYSES LABORATORY NUMBERS
USBM/DOE: --
USGS: D188249

APPARENT RANK OF COAL:

THICKNESS OF COAL:
Feet: -- Meters: --

THICKNESS SAMPLED:
Feet: 0.5 Meters: 0.2

TYPE OF SAMPLE: Roof rock

Table F1. Proximate and ultimate analyses, heat-of-combustion, forms-of-sulfur, free-swelling-index and ash-fusion-temperature determinations for 22 coal samples from the Uinta Region, Colorado.

[All analyses except heat-of-combustion, free-swelling index, and ash-fusion temperatures in percent. For each sample number, the analyses are reported three ways: first, as received; second, moisture free; and third, moisture and ash free. All analyses by Coal Analysis Section, U.S. Department of Energy, Pittsburgh, Pa. °F = (°C x 1.8) + 32; Kcal/kg = 0.556 (Btu/lb), L, less than the value shown]

Sample number	Proximate Analysis				Ultimate Analysis					Heat of Combustion	
	Moisture	Volatile matter	Fixed carbon	Ash	Hydrogen	Carbon	Nitrogen	Oxygen	Sulfur	Kcal/kg	Btu/lb
D184636	4.0	39.3	50.7	6.0	5.4	70.4	1.8	14.8	1.5	7,000	12,610
	---	40.9	52.8	6.2	5.2	73.3	1.9	11.7	1.6	7,300	13,130
	---	43.7	56.3	---	5.5	78.2	2.0	12.5	1.7	7,780	14,010
D184637	.8	22.7	69.0	7.5	4.8	81.9	1.9	3.3	.5	8,060	14,500
	---	22.9	69.6	7.6	4.7	82.6	1.9	2.6	.5	8,120	14,620
	---	24.8	75.2	---	5.1	89.3	2.1	2.8	.5	8,790	15,820
D184647	3.2	37.7	51.8	7.3	5.3	73.1	1.6	12.2	.6	7,300	13,130
	---	38.9	53.5	7.5	5.1	75.5	1.7	9.7	.6	7,540	13,570
	---	42.1	57.9	---	5.5	81.7	1.8	10.5	.7	8,150	14,670
D184650	4.5	36.0	53.8	5.7	5.7	72.7	1.7	13.8	.5	7,230	13,020
	---	37.7	56.3	6.0	5.4	76.1	1.8	10.3	.5	7,580	13,640
	---	40.1	59.9	---	5.8	81.0	1.9	10.9	.6	8,060	14,500
D184652	5.3	35.3	52.5	6.9	5.5	71.1	1.5	14.3	.6	7,050	12,690
	---	37.3	55.4	7.3	5.2	75.1	1.6	10.1	.6	7,440	13,400
	---	40.2	59.8	---	5.6	81.0	1.7	10.9	.7	8,030	14,450
D184653	4.8	37.5	54.5	3.2	5.7	74.9	1.6	13.9	.6	7,470	13,450
	---	39.4	57.2	3.4	5.4	78.7	1.7	10.1	.6	7,850	14,130
	---	40.8	59.2	---	5.6	81.4	1.7	10.5	.7	8,120	14,620
D196214	4.7	39.4	49.8	6.1	5.5	71.0	1.4	15.3	.6	6,990	12,580
	---	41.3	52.3	6.4	5.2	74.5	1.5	11.7	.6	7,330	13,200
	---	44.2	55.8	---	5.6	79.6	1.6	12.5	.7	7,840	14,100
D196215	4.8	38.7	50.0	6.5	5.6	71.4	1.4	14.5	.6	6,980	12,560
	---	40.7	52.5	6.8	5.3	75.0	1.5	10.7	.6	7,330	13,190
	---	43.6	56.4	---	5.7	80.5	1.6	11.5	.7	7,870	14,160
D196216	4.5	37.2	48.3	10.0	5.4	68.2	1.4	14.3	.7	6,700	12,060
	---	39.0	50.6	10.5	5.1	71.4	1.5	10.8	.7	7,020	12,630
	---	43.5	56.5	---	5.7	79.8	1.6	12.0	.8	7,840	14,110
D196217	4.3	39.2	46.1	10.4	5.5	68.0	1.4	14.1	.6	6,750	12,150
	---	41.0	48.2	10.9	5.2	71.1	1.5	10.7	.6	7,050	12,690
	---	46.0	54.0	---	5.9	79.7	1.6	12.0	.7	7,910	14,240
D196218	4.0	39.8	48.0	8.2	5.5	69.7	.9	15.3	.4	6,860	12,350
	---	41.5	50.0	8.5	5.3	72.6	.9	12.2	.4	7,150	12,860
	---	45.3	54.7	---	5.8	79.4	1.0	13.4	.5	7,810	14,070

Table F1. Proximate and ultimate analyses, heat-of-combustion, forms-of-sulfur, free-swelling-index and ash-fusion-temperature determinations for 22 coal samples from the Uinta Region, Colorado (cont.).

Sample number	Air-dried loss	Forms of sulfur			Free swelling	Ash fusion temperature C		
		Sulfate	Pyritic	Organic		Initial deformation	softening	fluid
D184636	0.8	0.10	0.78	0.66	1.0	1,240	1,285	1,345
	---	.10	.81	.69				
	---	.11	.87	.73				
D184637	.3	.01	.03	.48	9.0	1,280	1,330	1,375
	---	.01	.03	.48				
	---	.01	.03	.52				
D184647	.9	.01	.03	.55	2.0	1,295	1,355	1,420
	---	.01	.03	.57				
	---	.01	.03	.61				
D184650	1.0	.01	.03	.49	2.0	1,345	1,400	1,470
	---	.01	.03	.51				
	---	.01	.03	.55				
D184652	1.6	.01L	.03	.57	2.0	1,520	1,540	1,540
	---	.01L	.03	.60				
	---	.01L	.03	.65				
D184653	1.6	.01	.11	.50	2.0	1,175	1,230	1,285
	---	.01	.12	.53				
	---	.01	.12	.54				
D196214	.2	.01L	.07	.53	1.0	1,330	1,360	1,390
	---	.01L	.07	.56				
	---	.01L	.08	.59				
D196215	.9	.01	.09	.49	1.5	1,600	1,600	1,600
	---	.01	.09	.51				
	---	.01	.10	.55				
D196216	.6	.02	.08	.55	1.0	1,600	1,600	1,600
	---	.02	.08	.58				
	---	.02	.09	.64				
D196217	1.1	.02	.04	.56	1.5	1,600	1,600	1,600
	---	.02	.04	.59				
	---	.02	.05	.66				
D196218	B	.01	.03	.38	1.0	1,220	1,250	1,315
	---	.01	.03	.40				
	---	.01	.03	.43				

Table F1. Proximate and ultimate analyses, heat-of-combustion, forms-of-sulfur, free-swelling-index and ash-fusion-temperature determinations for 22 coal samples from the Uinta Region, Colorado (cont.).

Sample number	Proximate Analysis				Ultimate Analysis					Heat of Combustion	
	Moisture	Volatile matter	Fixed carbon	Ash	Hydrogen	Carbon	Nitrogen	Oxygen	Sulfur	Kcal/kg	Btu/lb
D196219	1.0	27.3	63.2	8.5	5.0	79.7	1.7	3.8	1.3	7,810	14,070
	---	27.6	63.8	8.6	4.9	80.5	1.7	2.9	1.3	7,890	14,210
	---	30.2	69.8	---	5.4	88.1	1.9	3.2	1.4	8,630	15,540
D196220	.8	28.1	65.4	5.7	5.3	82.6	1.9	4.2	.3	8,150	14,670
	---	28.3	65.9	5.7	5.3	83.3	1.9	3.5	.3	8,210	14,790
	---	30.1	69.9	---	5.6	88.3	2.0	3.7	.3	8,710	15,690
D196221	.8	25.9	69.4	3.9	5.3	85.7	1.9	2.6	.5	8,380	15,090
	---	26.1	70.0	3.9	5.3	86.4	1.9	1.9	.5	8,450	15,210
	---	27.2	72.8	---	5.5	89.9	2.0	2.0	.5	8,800	15,830
D196222	1.0	23.9	68.6	6.5	5.0	82.8	1.9	3.5	.4	8,110	14,600
	---	24.1	69.3	6.6	4.9	83.6	1.9	2.6	.4	8,190	14,750
	---	25.8	74.2	---	5.3	89.5	2.1	2.8	.4	8,770	15,780
D196223	1.0	21.8	69.6	7.6	4.9	81.7	1.9	3.6	.4	8,050	14,490
	---	22.0	70.3	7.7	4.8	82.5	1.9	2.7	.4	8,130	14,630
	---	23.9	76.1	---	5.2	89.4	2.1	3.0	.4	8,810	15,850
D208585	13.4	34.9	45.3	6.4	5.7	62.0	1.5	24.0	.4	6,060	10,910
	---	40.3	52.3	7.4	4.9	71.6	1.7	14.0	.5	7,000	12,590
	---	43.5	56.5	---	5.3	77.3	1.9	15.1	.5	7,550	13,600
D208586	12.3	35.7	46.4	5.6	5.9	62.8	1.6	23.6	.5	6,160	11,080
	---	40.7	52.9	6.4	5.2	71.6	1.8	14.4	.6	7,020	12,630
	---	43.5	56.5	---	5.5	76.5	1.9	15.4	.6	7,500	13,490
D208587	1.4	10.3	82.9	5.4	4.1	84.1	2.0	3.8	.6	7,950	14,310
	---	10.4	84.1	5.5	4.0	85.3	2.0	2.6	.6	8,060	14,510
	---	11.1	88.9	---	4.2	90.2	2.1	2.7	.6	8,530	15,350
D208588	1.4	8.1	86.1	4.4	3.7	87.0	1.7	2.6	.6	8,020	14,440
	---	8.2	87.3	4.5	3.6	88.2	1.7	1.4	.6	8,130	14,640
	---	8.6	91.4	---	3.8	92.4	1.8	1.4	.6	8,510	15,330
D208589	1.7	28.7	58.3	11.3	5.3	75.3	2.1	5.3	.6	7,470	13,450
	---	29.2	59.3	11.5	5.2	76.6	2.1	3.9	.6	7,600	13,680
	---	33.0	67.0	---	5.9	86.6	2.4	4.4	.7	8,590	15,460
D208590	1.8	33.0	59.2	6.0	5.8	80.0	2.1	5.6	.6	7,950	14,310
	---	33.6	60.3	6.1	5.7	81.5	2.1	4.1	.6	8,090	14,570
	---	35.8	64.2	---	6.1	86.8	2.3	4.3	.7	8,620	15,520

Table F1. Proximate and ultimate analyses, heat-of-combustion, forms-of-sulfur, free-swelling-index and ash-fusion-temperature determinations for 22 coal samples from the Uinta Region, Colorado (cont.).

Sample number	Air-dried loss	Forms of sulfur			Free swelling	Ash fusion temperature C		
		Sulfate	Pyritic	Organic		Initial deformation	softening	fluid
D196219	B	0.10	0.60	0.56	8.5	1,110	1,140	1,305
	---	.10	.61	.57				
	---	.11	.66	.62				
D196220	B	.02	.03	.28	8.5	1,170	1,200	1,310
	---	.02	.03	.28				
	---	.02	.03	.30				
D196221	B	.02	.03	.50	9.0	1,200	1,230	1,345
	---	.02	.03	.50				
	---	.02	.03	.52				
D196222	B	.01	.01	.34	9.0	1,230	1,260	1,325
	---	.01	.01	.34				
	---	.01	.01	.37				
D196223	B	.01	.03	.36	9.0	1,195	1,220	1,295
	---	.01	.03	.36				
	---	.01	.03	.39				
D208585	10.3	.01	.03	.39	1.0	1,240	1,300	1,345
	---	.01	.03	.45				
	---	.01	.04	.49				
D208586	8.9	.01	.05	.40	.0	1,210	1,270	1,325
	---	.01	.06	.46				
	---	.01	.06	.49				
D208587	.6	.01	.06	.55	.0	1,125	1,175	1,240
	---	.01	.06	.56				
	---	.01	.06	.59				
D208588	.6	.01	.04	.57	.0	1,150	1,210	1,260
	---	.01	.04	.58				
	---	.01	.04	.61				
D208589	1.1	.01	.08	.54	9.0	1,320	1,370	1,430
	---	.01	.08	.55				
	---	.01	.09	.62				
D208590	1.1	.01	.14	.44	9.0	1,270	1,320	1,375
	---	.01	.14	.45				
	---	.01	.15	.48				

Table F2. Major- and minor-oxide and trace element composition of the laboratory ash of 36 coal and coal-associated rock samples from the Uinta Region, Colorado.

[Values in percent or parts per million. Coal and shale ashed at 525°C. S after element title indicates determinations by semiquantitative emission spectrography. The spectrographic results are to be identified with geometric brackets whose boundaries are part of the ascending series 0.12, 0.18, 0.26, 0.38, 1.2, etc. but reported as midpoints of the brackets, 0.1, 0.15, 0.2, 0.3, 0.5, 0.7, 1.0, etc. Precision of the spectrographic data is plus-or-minus one bracket at 68 percent or plus-or-minus two brackets at 95 percent confidence level. L, less than the value shown; N, not detected].

Sample number	Ash (percent)	SiO2 (percent)	Al2O3 (percent)	CaO (percent)	MgO (percent)	Na2O (percent)	K2O (percent)	Fe2O3 (percent)	TiO2 (percent)	P2O5 (percent)	Sample number
D184636	6.4	22	21	16	0.34	0.53	0.47	21	0.85	8.3	D184636
D184637	9.2	43	23	9.4	1.59	3.70	.57	5.2	1.0	1.0L	D184637
D184638	7.9	43	24	8.5	1.91	3.33	.48	5.0	1.0	1.0L	D184638
D184647	4.4	54	20	5.9	2.00	2.65	.49	4.6	1.1	1.0L	D184647
D184648	53.9	60	27	2.0	1.25	2.30	.87	1.6	1.0	1.0L	D184648
D184649	8.6	64	14	5.7	2.05	1.50	.94	3.9	.77	1.0L	D184649
D184650	8.9	51	24	6.0	1.73	2.65	.59	5.3	.68	1.9	D184650
D184651	3.0	38	25	11	1.09	2.53	.50	9.5	1.3	3.7	D184651
D184652	6.8	50	22	9.3	1.07	.61	1.6	5.8	.97	1.0L	D184652
D184653	4.7	22	16	22	3.00	.64	.46	23	.83	1.1	D184653
D184654	2.6	33	21	12	1.57	1.96	.31	16	1.4	1.0L	D184654
D188247	24.3	59	25	1.4	1.01	.72	2.5	3.4	1.0	1.0L	D188247
D188248	56.9	66	22	.67	.91	.67	2.6	2.2	1.0	1.0L	D188248
D188249	79.7	64	16	2.5	1.33	1.33	3.2	4.1	.88	1.0L	D188249
D196214	6.7	42	28	6.7	.73	1.21	.40	2.1	1.1	.10	D196214
D196215	6.9	46	28	4.8	.67	1.19	.40	2.7	1.2	.040	D196215
D196216	11.6	52	36	2.1	.37	.73	.40	1.4	1.2	.020	D196216
D196217	12.2	56	31	2.7	.39	.50	.70	.60	1.2	.010L	D196217
D196218	9.4	33	21	13	1.55	1.04	.30	5.2	1.0	.010L	D196218
D196219	10.2	61	15	2.2	.91	.95	.20	9.8	1.0	.080	D196219
D196220	6.1	43	17	7.1	2.31	2.46	.60	9.3	1.0	.060	D196220
D196221	4.1	35	19	7.8	2.23	4.20	.30	7.0	1.1	.050	D196221
D196222	7.5	45	22	6.8	2.16	4.40	.30	3.8	1.0	.20	D196222
D196223	7.9	53	20	4.8	2.16	3.15	.30	3.5	.90	.10	D196223
D196434	9.7	40	19	16	.73	.60	.60	1.9	.80	1.0L	D196434
D196435	90.8	62	18	2.4	2.55	.80	3.6	2.3	.80	1.0L	D196435
D196436	80.4	82	18	.30	.76	.08	2.4	1.1	1.0	1.0L	D196436
D196437	88.0	92	11	.30	.35	.88	1.9	.40	.70	1.0L	D196437
D196438	71.2	61	25	.60	.44	1.00	2.0	2.6	1.0	1.0L	D196438
D208580	6.2	41	14	9.8	1.26	.24	.060	23	.75	3.4	D208580
D208585	7.7	39	26	9.2	2.32	1.22	.24	9.6	.78	.65	D208585
D208586	5.3	36	25	9.8	1.48	.12	.24	13	.85	2.6	D208586
D208587	4.6	36	25	6.9	2.65	1.62	.62	21	1.1	3.0	D208587
D208588	4.8	30	23	9.0	2.49	.95	.43	24	.89	.62	D208588
D208589	11.7	45	34	5.2	.81	2.57	.49	3.6	1.0	1.4	D208589
D208590	6.2	36	23	10	2.49	.03	.43	12	.87	.65	D208590

Table F2. Major- and minor-oxide and trace element composition of the laboratory ash of 36 coal and coal-associated rock samples from the Uinta Region, Colorado (cont.).

Sample number	SO3 (percent)	B-S (ppm)	Ba-S (ppm)	Be-S (ppm)	Cd (ppm)	Co-S (ppm)	Cr-S (ppm)	Cu (ppm)	Ga-S (ppm)	Ge-S (ppm)	Sample number
D184636	6.6	2,000	3,000	7	1.0L	B	B	72	30	N	D184636
D184637	5.7	700	3,000	5	1.0L	B	B	53	30	N	D184637
D184638	5.1	700	3,000	3	1.0L	B	B	67	30	N	D184638
D184647	2.5	2,000	2,000	20	1.0	20	20	90	30	70	D184647
D184648	.44	200	1,000	N	1.0L	B	B	42	30	N	D184648
D184649	2.6	1,000	1,500	3	1.0L	15	20	77	20	N	D184649
D184650	2.1	1,000	1,500	5	1.0L	B	B	52	30	N	D184650
D184651	3.2	3,000	5,000	3	2.0	B	B	115	30	N	D184651
D184652	2.7	1,500	1,000	5	1.0L	B	B	103	30	N	D184652
D184653	6.9	1,500	2,000	N	1.0L	B	B	67	20	N	D184653
D184654	7.5	2,000	3,000	3	1.0L	B	B	158	20	N	D184654
D188247	.50	300	700	N	2.0	15	70	99	30	N	D188247
D188248	.20	100	700	2	1.0	7	70	62	30	N	D188248
D188249	.75	100	700	3	1.0L	15	50	46	30	N	D188249
D196214	3.5	2,000	3,000	7	1.0L	B	B	77	70	N	D196214
D196215	4.3	2,000	3,000	5	1.0L	B	B	85	70	N	D196215
D196216	1.5	1,000	2,000	5	1.0	B	B	65	70	N	D196216
D196217	1.3	1,000	2,000	10	1.0L	B	B	61	100	N	D196217
D196218	6.5	700	3,000	5	1.0L	B	B	42	70	N	D196218
D196219	3.5	200	2,000	10	1.0L	B	B	58	50	N	D196219
D196220	9.7	500	5,000	3	1.0L	B	B	73	30	N	D196220
D196221	10	700	5,000	7	3.0	B	B	85	50	N	D196221
D196222	4.7	1,000	5,000	7	1.0L	B	B	49	70	N	D196222
D196223	3.5	700	3,000	3	1.0L	B	B	54	50	N	D196223
D196434	2.7	1,500	1,500	3	2.0	10	30	106	30	N	D196434
D196435	.080L	150	1,500	3	1.0	15	70	65	30	N	D196435
D196436	.080L	100	300	7	1.0L	N	50	29	30	N	D196436
D196437	.080L	200	500	N	1.0L	N	30	20	20	N	D196437
D196438	.40	150	2,000	3	1.0L	10L	20	47	70	N	D196438
D208580	7.8	1,500	1,000	3	1.0	B	B	47	30	30	D208580
D208585	3.0	300	1,500	N	3.0	B	B	58	30	N	D208585
D208586	5.0	1,000	1,000	10	2.0	B	B	70	50	50	D208586
D208587	3.0	100	2,000	5	1.0	B	B	85	50	N	D208587
D208588	4.0	70	2,000	5	1.0	B	B	86	30	N	D208588
D208589	.50	700	3,000	3	1.0	B	B	51	70	N	D208589
D208590	4.5	500	3,000	3	1.0	B	B	59	30	N	D208590

Table F2. Major- and minor-oxide and trace element composition of the laboratory ash of 36 coal and coal-associated rock samples from the Uinta Region, Colorado (cont.).

Sample number	La-S (ppm)	Li (ppm)	Mn (ppm)	Mo-S (ppm)	Nb-S (ppm)	Nd-S (ppm)	Ni-S (ppm)	Pb (ppm)	Sc-S (ppm)	Sr-S (ppm)	Sample number
D184636	150	143	85	7	30	150	30	50	10	5,000	D184636
D184637	100L	88	95	7L	30	N	15	30	10	1,000	D184637
D184638	100L	103	75	7L	30	N	10	60	10	1,000	D184638
D184647	100	63	90	7	50	N	30	50	30	1,000	D184647
D184648	100L	35	75	N	30	N	10L	35	10L	500	D184648
D184649	100L	46	80	7	30	N	15	35	15	1,500	D184649
D184650	100	70	50	7L	30	N	10	55	10L	1,000	D184650
D184651	100	119	50	15	30	150L	30	50	15	3,000	D184651
D184652	100L	69	105	15	30	150L	30	40	20	700	D184652
D184653	N	95	185	7	20	B	15	25L	10L	1,000	D184653
D184654	100L	87	120	20	30	N	70	40	15	1,500	D184654
D188247	100	64	55	N	20	N	15	55	20	300	D188247
D188248	70	88	40	N	20	N	7	40	15	200	D188248
D188249	100	36	170	N	30	N	50	50	15	300	D188249
D196214	150	116	160	30	20	N	20	45	15	2,000	D196214
D196215	N	139	155	30	20	B	30	55	15	2,000	D196215
D196216	70	127	62	15	30	N	15	70	15	1,000	D196216
D196217	150	111	110	15	50	N	20	75	30	1,000	D196217
D196218	70	118	1,160	N	20	N	30	40	15	2,000	D196218
D196219	70	100	130	15	20	N	50	35	15	1,500	D196219
D196220	N	98	125	10	20	B	30	35	15	3,000	D196220
D196221	150	144	120	10	30	N	30	50	20	5,000	D196221
D196222	150	69	64	10	30	N	20	35	15	5,000	D196222
D196223	70	75	205	7	20	N	15	35	10	2,000	D196223
D196434	N	89	410	20	N	B	20	55	15	700	D196434
D196435	70	54	225	N	20L	N	50	25L	20	300	D196435
D196436	70	41	54	N	20	N	15	25	15	50	D196436
D196437	70	41	44	N	20	N	10L	25L	N	70	D196437
D196438	70	194	72	N	20L	N	20	50	10	150	D196438
D208580	100L	73	1,030	N	20L	N	70	144	20	2,000	D208580
D208585	N	85	442	10	N	B	30	25L	10L	500	D208585
D208586	100	133	470	10	20	N	50	25L	15	1,500	D208586
D208587	100L	115	825	7	20L	N	50	25L	20	2,000	D208587
D208588	100L	122	636	7	N	N	70	25L	20	1,500	D208588
D208589	100	174	122	7	20L	N	15	33	15	2,000	D208589
D208590	100L	146	644	7	20	N	30	25L	15	1,500	D208590

Table F2. Major- and minor-oxide and trace element composition of the laboratory ash of 36 coal and coal-associated rock samples from the Uinta Region, Colorado (cont.).

Sample number	V-S (ppm)	Y-S (ppm)	Yb-S (ppm)	Zn (ppm)	Zr-S (ppm)
D184636	50	70	7	120	150
D184637	70	30	3	35	100
D184638	50	50	5	55	150
D184647	100	70	7	75	200
D184648	70	20L	2L	105	200
D184649	70	30	3	66	150
D184650	30	30	5	84	300
D184651	100	70	7	97	300
D184652	150	70	7	99	150
D184653	50	30	3	44	70
D184654	100	70	7	64	200
D188247	200	30	5	79	150
D188248	150	50	5	77	150
D188249	70	50	5	140	300
D196214	70	50	5	51	200
D196215	100	50	5	47	300
D196216	70	50	5	42	300
D196217	100	70	7	89	500
D196218	70	50	5	38	300
D196219	70	70	7	96	300
D196220	70	30	3	41	200
D196221	100	50	5	49	200
D196222	70	50	5	46	300
D196223	70	30	3	67	300
D196434	150	30	3	60	150
D196435	150	30	3	148	200
D196436	100	30	3	22	150
D196437	70	20L	2	31	300
D196438	100	30	3	127	300
D208580	70	50	B	64	200
D208585	70	30	3	159	200
D208586	70	70	7	61	200
D208587	100	70	5	62	200
D208588	70	70	5	29	200
D208589	70	70	5	54	300
D208590	70	70	7	20L	300

Table F3. Content of 9 trace elements in 36 coal and coal-associated rock samples from the Uinta Region, Colorado.

[Analyses on air-dried (32°C) coal and shale. L, less than the value shown]

Sample number	As (ppm)	Co (ppm)	Cr (ppm)	F (ppm)	Hg (ppm)	Sb (ppm)	Se (ppm)	Th (ppm)	U (ppm)	Sample number
D184636	3.1	1.2	1.4	445	0.14	0.1	1.4	2.0	1.4	D184636
D184637	1.4	.6	1.6	90	.01	.1	1.0	1.7	.7	D184637
D184638	B	.8	1.8	65	.01	.2	1.1	2.9	.9	D184638
D184647	.5	B	B	95	.03	B	B	3.0L	.4	D184647
D184648	1.8	3.9	3.1	750	.06	.1	2.7	6.8	1.7	D184648
D184649	.4	B	B	85	.01	B	B	3.0L	.6	D184649
D184650	.2	B	B	215	.01	.2	.6	4.5	1.6	D184650
D184651	.3	.5	1.2	185	.01	.1	.6	.9	.3	D184651
D184652	.5	1.5	4.4	60	.01	.3	.7	1.8	1.3	D184652
D184653	.2	.6	1.1	85	.01	.1	.4	.5	.5	D184653
D184654	.4	.8	1.5	35	.01	.1	.5	.6	.3	D184654
D188247	1.5	B	B	210	.13	.9	2.1	6.4	3.3	D188247
D188248	.5	B	B	440	.08	1.2	1.8	13	4.3	D188248
D188249	26	B	B	710	.98	1.8	3.7	13	4.3	D188249
D196214	1.7	1.3	1.5	85	.02	.1	.8	1.0	.4	D196214
D196215	2.1	1.6	2.3	40	.03	.2	.9	1.3	.7	D196215
D196216	.4	1.3	2.1	35	.10	.2	.8	2.6	.4	D196216
D196217	1.4	2.3	3.5	55	.03	.3	1.9	3.4	1.2	D196217
D196218	.9	1.4	2.4	25	.03	.3	1.5	4.6	1.1	D196218
D196219	2.5	1.4	3.8	70	.02	.2	1.2	1.4	.1	D196219
D196220	.2	1.3	2.1	45	.31	.1	.6	1.0	.3L	D196220
D196221	.4	.8	1.5	55	.01	B	.6	.7	.2L	D196221
D196222	.1	.9	1.6	200	.01	.2	.8	2.0	.1	D196222
D196223	.5	1.0	1.8	130	.02	.2	1.1	2.1	.2	D196223
D196434	1.6	B	B	25	.01L	1.1	1.5	3.6L	2.3	D196434
D196435	6.7	B	B	900	.05	1.9	2.1	14	4.5	D196435
D196436	1.4	N	B	300	.01L	4.5	1.4	10	2.2	D196436
D196437	2.0	N	B	135	.04	.9	1.1	6.8	2.9	D196437
D196438	25	B	B	285	.17	4.4	3.7	12	3.0	D196438
D208580	2.6	3.6	2.6	180	.14	.5	1.1	1.0	.6	D208580
D208585	.7	.8	2.5	90	.06	.1L	.6	1.6	.9	D208585
D208586	.4	1.1	2.0	130	.06	.4	1.4	1.9	2.1	D208586
D208587	.4	1.1	2.7	120	.06	.1L	.9	1.5	1.1	D208587
D208588	.3	1.6	1.7	35	.07	.1	.7	.8	.3	D208588
D208589	.3	1.3	.1L	100	.07	.3	1.5	3.8	1.1	D208589
D208590	.7	1.0	3.1	40	.10	.3	.1L	2.0	1.2	D208590

Table F4. Major-, minor- and trace-element composition of 36 coal and coal-associated rock samples from the Uinta Region, Colorado.

[Values in percent or parts per million. As, Co, Cr, F, Hg, Sb, Se, Th, and U values are from direct determinations on air-dried (32°C) coal and shale; all other values calculated from analyses of ash. S means analysis by emission spectrography; L, less than the value shown; N, not detected].

Sample number	Si (percent)	Al (percent)	Ca (percent)	Mg (percent)	Na (percent)	K (percent)	Fe (percent)	Ti (percent)	As (ppm)	B-S (ppm)	Sample number
D184636	0.66	0.71	0.73	0.013	0.025	0.025	0.94	0.033	3.1	150	D184636
D184637	1.8	1.1	.62	.088	.25	.044	.33	.055	1.4	70	D184637
D184638	1.6	1.0	.48	.091	.19	.032	.28	.047	B	50	D184638
D184647	1.1	.47	.19	.053	.086	.018	.14	.029	.5	100	D184647
D184648	15	7.7	.77	.41	.92	.39	.60	.32	1.8	100	D184648
D184649	2.6	.64	.35	.11	.096	.067	.23	.040	.4	100	D184649
D184650	2.1	1.1	.38	.093	.17	.044	.33	.036	.2	100	D184650
D184651	.53	.40	.24	.020	.056	.012	.20	.023	.3	100	D184651
D184652	1.6	.79	.45	.044	.031	.091	.28	.040	.5	100	D184652
D184653	.48	.40	.74	.085	.022	.018	.76	.023	.2	70	D184653
D184654	.40	.29	.22	.025	.038	.007	.29	.022	.4	50	D184654
D188247	6.7	3.2	.24	.15	.13	.51	.58	.15	1.5	70	D188247
D188248	18	6.6	.27	.31	.28	1.2	.88	.34	.5	70	D188248
D188249	24	6.7	1.4	.64	.79	2.1	2.3	.42	26	70	D188249
D196214	1.3	.99	.32	.029	.060	.022	.098	.044	1.7	150	D196214
D196215	1.5	1.0	.24	.028	.061	.023	.13	.050	2.1	150	D196215
D196216	2.8	2.2	.17	.026	.063	.039	.11	.083	.4	100	D196216
D196217	3.2	2.0	.24	.029	.045	.071	.051	.088	1.4	150	D196217
D196218	1.4	1.0	.87	.068	.072	.023	.34	.056	.9	70	D196218
D196219	2.9	.81	.16	.056	.072	.017	.70	.061	2.5	20	D196219
D196220	1.2	.55	.31	.085	.11	.030	.40	.037	.2	30	D196220
D196221	.67	.41	.23	.055	.13	.010	.20	.027	.4	30	D196221
D196222	1.6	.87	.36	.098	.24	.019	.20	.045	.1	70	D196222
D196223	2.0	.84	.27	.10	.18	.020	.19	.043	.5	50	D196223
D196434	1.8	.97	1.1	.043	.043	.048	.13	.046	1.6	150	D196434
D196435	26	8.6	1.6	1.4	.54	2.7	1.5	.44	6.7	150	D196435
D196436	23	5.8	.13	.28	.036	1.2	.46	.36	1.4	70	D196436
D196437	38	5.1	.19	.19	.57	1.4	.25	.37	2.0	150	D196437
D196438	20	9.4	.31	.19	.53	1.2	1.3	.43	25	100	D196438
D208580	1.2	.46	.43	.047	.011	.003	.99	.028	2.6	100	D208580
D208585	1.4	1.1	.51	.11	.070	.015	.52	.036	.7	20	D208585
D208586	.90	.69	.37	.047	.005	.011	.49	.027	.4	50	D208586
D208587	.78	.60	.23	.073	.055	.024	.69	.029	.4	5	D208587
D208588	.67	.50	.31	.072	.034	.017	.82	.026	.3	3	D208588
D208589	2.5	2.1	.43	.057	.22	.048	.29	.070	.3	70	D208589
D208590	1.1	.74	.45	.093	.001	.022	.52	.032	.7	30	D208590

Table F4. Major-, minor- and trace-element composition of 36 coal and coal-associated rock samples from the Uinta Region, Colorado (cont.).

Sample number	Ba-S (ppm)	Be-S (ppm)	Cd (ppm)	Co (ppm)	Cr (ppm)	Cu (ppm)	F (ppm)	Ga-S (ppm)	Ge-S (ppm)	Hg (ppm)	Sample number
D184636	200	0.5	0.06L	1.2	1.4	4.6	445	2	N	0.14	D184636
D184637	300	.5	.09L	.8	1.6	4.9	90	3	N	.01	D184637
D184638	200	.2	.08L	.8	1.8	5.3	65	2	N	.01	D184638
D184647	100	1	.04	1	1	4.0	95	1.5	3	.03	D184647
D184648	500	N	.54L	3.9	3.1	23	750	15	N	.06	D184648
D184649	150	.2	.09L	1.5	1.5	6.6	85	1.5	N	.01	D184649
D184650	150	.5	.09L	B	B	4.6	215	3	N	.01	D184650
D184651	150	.1	.06	.5	1.2	3.5	185	1	N	.01	D184651
D184652	70	.3	.07L	1.5	4.4	7.0	60	2	N	.01	D184652
D184653	100	N	.05L	.6	1.1	3.1	85	1	N	.01	D184653
D184654	70	.07	.03L	.8	1.5	4.1	35	.5	N	.01	D184654
D188247	150	N	.49	3	15	24	210	7	N	.13	D188247
D188248	500	1	.57	5.0	50	35	440	15	N	.08	D188248
D188249	500	2	.80L	10	50	37	710	20	N	.98	D188249
D196214	200	.5	.07L	1.3	1.5	5.2	85	5	N	.02	D196214
D196215	200	.3	.07L	1.6	2.3	5.9	40	5	N	.03	D196215
D196216	200	.7	.12	1.3	2.1	7.5	35	7	N	.10	D196216
D196217	200	1.5	.12L	2.3	3.5	7.4	55	15	N	.03	D196217
D196218	300	.5	.09L	1.4	2.4	3.9	25	7	N	.03	D196218
D196219	200	1	.10L	1.4	3.8	5.9	70	5	N	.02	D196219
D196220	300	.2	.06L	1.3	2.1	4.5	45	2	N	.31	D196220
D196221	200	.3	.12	.8	1.5	3.5	55	2	N	.01	D196221
D196222	300	.5	.08L	.9	1.6	3.7	200	5	N	.01	D196222
D196223	200	.2	.08L	1.0	1.6	4.3	130	5	N	.02	D196223
D196434	150	.3	.19	1.0	3.0	10	25	3	N	.01L	D196434
D196435	1,500	3	.91	15	70	59	900	30	N	.05	D196435
D196436	200	5	.60L	N	30	18	300	20	N	.01L	D196436
D196437	500	N	.88L	N	30	18	135	15	N	.04	D196437
D196438	1,500	2	.71L	7L	15	33	285	50	N	.17	D196438
D208580	70	.2	.06	3.6	2.6	2.9	180	2	2	.14	D208580
D208585	100	N	.23	.8	2.5	4.5	90	2	N	.06	D208585
D208586	50	.5	.11	1.1	2.0	3.7	130	3	3	.06	D208586
D208587	100	.2	.05	1.1	2.7	3.9	120	2	N	.06	D208587
D208588	100	.2	.05	1.6	1.7	4.1	35	1.5	N	.07	D208588
D208589	300	.3	.12	1.3	.1L	6.0	100	7	N	.07	D208589
D208590	200	.2	.06	1.0	3.1	3.7	40	2	N	.10	D208590

Table F4. Major-, minor- and trace-element composition of 36 coal and coal-associated rock samples from the Uinta Region, Colorado (cont.).

Sample number	La-S (ppm)	Li (ppm)	Mn (ppm)	Mo-S (ppm)	Nb-S (ppm)	Nd-S (ppm)	Ni-S (ppm)	P (ppm)	Pb (ppm)	Sb (ppm)	Sample number
D184636	10	9.2	5.4	0.5	2	10	2	2,300	3.2	0.1	D184636
D184637	10L	8.1	8.7	.7L	3	N	1.5	400L	2.8	.1	D184637
D184638	7L	8.1	5.9	.5L	2	N	.7	350L	4.7	.2	D184638
D184647	5	2.8	4.0	.3	2	N	1.5	190L	2.2	B	D184647
D184648	50L	19	40	N	15	N	5L	2,400L	19	.1	D184648
D184649	10L	4.0	6.9	.7	2	N	1.5	380L	3.0	B	D184649
D184650	10	6.2	4.5	.7L	3	N	1	740	4.9	.2	D184650
D184651	3	3.6	1.5	.5	1	5L	1	490	1.5	.1	D184651
D184652	7L	4.7	7.1	1	2	10L	2	300L	2.7	.3	D184652
D184653	N	4.5	8.7	.3	1	B	.7	230	1.2L	.1	D184653
D184654	2L	2.3	3.1	.5	.7	N	2	110L	1.0	.1	D184654
D188247	20	16	13	N	5	N	3	1,100L	13	.9	D188247
D188248	50	50	23	N	10	N	5	2,500L	23	1.2	D188248
D188249	70	29	140	N	20	N	50	3,500L	40	1.8	D188249
D196214	10	7.8	11	2	1.5	N	1.5	29	3.0	.1	D196214
D196215	N	9.6	11	2	1.5	B	2	12	3.8	.2	D196215
D196216	7	15	7.2	1.5	3	N	1.5	10	8.1	.2	D196216
D196217	20	14	13	2	7	N	2	5L	9.2	.3	D196217
D196218	7	11	110	N	2	N	3	4L	3.8	.3	D196218
D196219	7	10	13	1.5	2	N	5	36	3.6	.2	D196219
D196220	N	6.0	7.6	.7	1.5	B	2	16	2.1	.1	D196220
D196221	7	5.9	4.9	.5	1.5	N	1.5	9	2.1	B	D196221
D196222	10	5.2	4.8	.7	2	N	1.5	66	2.6	.2	D196222
D196223	5	5.9	16	.5	1.5	N	1	35	2.8	.2	D196223
D196434	N	8.6	40	2	N	B	2	420L	5.3	1.1	D196434
D196435	70	49	200	N	20L	N	50	4,000L	23L	1.9	D196435
D196436	50	25	33	N	10	N	10	2,600L	15	4.5	D196436
D196437	70	36	39	N	15	N	10L	3,800L	22L	.9	D196437
D196438	50	140	51	N	15L	N	15	3,100L	36	4.4	D196438
D208580	7L	4.5	64	N	1.5L	N	5	920	8.9	.5	D208580
D208585	N	6.5	34	.7	N	B	2	220	1.9L	.1L	D208585
D208586	5	7.0	25	.5	1	N	3	610	1.3L	.4	D208586
D208587	5L	5.3	38	.3	1L	N	2	610	1.2L	.1L	D208587
D208588	5L	5.9	31	.3	N	N	3	130	1.2L	.1	D208588
D208589	10	20	14	.7	2L	N	1.5	700	3.9	.3	D208589
D208590	7L	9.1	40	.5	1.5	N	2	180	1.6L	.3	D208590

Table F4. Major-, minor- and trace-element composition of 36 coal and coal-associated rock samples from the Uinta Region, Colorado (cont.).

Sample number	Sc-S (ppm)	Se (ppm)	Sr-S (ppm)	Th (ppm)	U (ppm)	V-S (ppm)	Y-S (ppm)	Yb-S (ppm)	Zn (ppm)	Zr-S (ppm)	Sample number
D184636	0.7	1.4	300	2.0	1.4	3	5	0.5	7.7	10	D184636
D184637	1	1.0	100	1.7	.7	7	3	.3	3.2	10	D184637
D184638	.7	1.1	70	2.9	.9	5	5	.5	4.3	10	D184638
D184647	1.5	B	50	3.0L	.4	5	3	.3	3.3	10	D184647
D184648	5L	2.7	300	6.8	1.7	30	10L	1L	57	100	D184648
D184649	1.5	B	150	3.0L	.6	7	2	.2	5.7	15	D184649
D184650	1L	.6	100	4.5	1.6	3	3	.5	7.5	30	D184650
D184651	.5	.6	100	.9	.3	3	2	.2	2.9	10	D184651
D184652	1.5	.7	50	1.8	1.3	10	5	.5	6.7	10	D184652
D184653	.5L	.4	50	.5	.5	2	1.5	.15	2.1	3	D184653
D184654	.5	.5	50	.6	.3	2	2	.2	1.7	5	D184654
D188247	5	2.1	70	6.4	3.3	50	7	1.5	19	30	D188247
D188248	10	1.8	100	13.0	4.3	100	30	3	44	100	D188248
D188249	10	3.7	200	13.0	4.3	50	50	5	110	200	D188249
D196214	1	.8	150	1.0	.4	5	3	.3	3.4	15	D196214
D196215	1	.9	150	1.3	.7	7	3	.3	3.2	20	D196215
D196216	1.5	.8	100	2.6	.4	7	7	.7	4.9	30	D196216
D196217	3	1.9	150	3.4	1.2	15	10	1	11	70	D196217
D196218	1.5	1.5	200	4.6	1.1	7	5	.5	3.6	30	D196218
D196219	1.5	1.2	150	1.4	.1	7	7	.7	9.8	30	D196219
D196220	1	.6	200	1.0	.3L	5	2	.2	2.5	15	D196220
D196221	.7	.6	200	.7	.2L	5	2	.2	2.0	7	D196221
D196222	1	.8	300	2.0	.1	5	3	.3	3.5	20	D196222
D196223	.7	1.1	150	2.1	.2	5	2	.2	5.3	20	D196223
D196434	1.5	1.5	70	3.6L	2.3	15	3	.3	5.8	15	D196434
D196435	20	2.1	300	14.0	4.5	150	30	3	130	200	D196435
D196436	10	1.4	30	10.0	2.2	70	20	2	13	100	D196436
D196437	N	1.1	70	6.8	2.9	70	15L	1.5	27	300	D196437
D196438	7	3.7	100	12.0	3.0	70	20	2	90	200	D196438
D208580	1.5	1.1	150	1.0	.6	5	3	B	4.0	15	D208580
D208585	.7L	.6	50	1.6	.9	5	2	.2	12	15	D208585
D208586	.7	1.4	70	1.9	2.1	3	3	.3	3.2	10	D208586
D208587	1	.9	100	1.5	1.1	5	3	.2	2.9	10	D208587
D208588	1	.7	70	.8	.3	3	3	.2	1.4	10	D208588
D208589	1.5	1.5	200	3.8	1.1	7	7	.7	6.3	30	D208589
D208590	1	.1L	100	2.0	1.2	5	5	.5	1.2L	20	D208590

Table F5. Arithmetic mean, observed range, geometric mean, and geometric deviation of proximate and ultimate analyses, heat of combustion, forms of sulfur, and ash-fusion temperatures of 36 coal samples from the Uinta Region, Colorado.

[All values are in percent except Kcal/kg, Btu/lb, ash-fusion temperatures, and geometric deviation and are reported on the as-received basis. °F = (C° x 1.8) + 32; Kcal/kg = 0.556 (Btu/lb)]

	Arithmetic mean	Observed range		Geometric mean	Geometric deviation
		Minimum	Maximum		
Proximate and ultimate analyses					
Moisture	3.8	0.8	13.4	2.6	2.4
Volatile matter	31.6	8.1	39.8	29.0	1.5
Fixed carbon	58.6	45.3	86.1	57.6	1.2
Ash	6.8	3.2	11.3	6.5	1.4
Hydrogen	5.3	3.7	5.9	5.2	1.1
Carbon	75.3	62.0	87.0	74.9	1.1
Nitrogen	1.8	.9	2.1	1.7	1.2
Oxygen	10.8	2.6	24	8.1	2.1
Sulfur	.6	.3	1.5	.6	1.4
Heat of combustion					
Kcal/kg	7,395	6,065	8,390	7,360	1.1
Btu/lb	13,300	10,910	15,090	13,240	1.1
Forms of sulfur					
Sulfate	0.02	0.01	0.1	0.01	2.1
Pyritic	.09	.01	.78	.06	2.7
Organic	.49	.28	.66	.48	1.2
Ash-fusion temperatures, °C					
Initial deformation	1,790	1,110	1,600	1,280	1.1
Softening temperature	1,330	1,135	1,600	1,320	1.1
Fluid temperature	1,385	1,235	1,600	1,380	1.1

Table F6. Arithmetic mean, observed range, geometric mean, and geometric deviation of ash content and contents of ten major and minor oxides in the laboratory ash of 36 coal samples from the Uinta Region, Colorado.

[All samples were ashed at 525°C; all analyses except geometric deviation are in percent; L, less than the value shown]

Oxide	Arithmetic mean	Observed range		Geometric mean	Geometric deviation
		Minimum	Maximum		
(Ash)	18	2.6	90.8	11	2.8
SiO_2	48	22	92	46	1.4
Al_2O_3	22	11	36	21	1.3
CaO	8.4	.30	22	4.7	2.9
MgO	1.5	.34	3	1.2	1.9
Na_2O	1.8	.03	4.4	1.0	3.0
K_2O	.89	.06	3.6	.61	2.4
Fe_2O_3	8.1	.40	24	4.8	2.8
TiO_2	.97	.68	1.4	.96	1.2
SO_3	4.7	.08L	10	2.1	3.7

Table F7. Arithmetic mean, observed range, geometric mean, and geometric deviation of 37 elements in 36 coal samples from the Uinta Region, Colorado.

[All analyses are in percent or parts per million and are reported on a whole-coal basis. As, F, Hg, Sb, Se, Th, and U values used to calculate the statistics were determined directly on whole coal. All other values used were calculated from determinations made on coal ash. L, less than the value shown]

Element	Arithmetic mean	Observed range		Geometric mean	Geometric deviation
		Minimum	Maximum		
Si	5.2	0.4	38	2.4	3.5
Al	2.0	.29	9.4	1.2	2.7
Ca	.45	.13	1.6	.37	1.8
Mg	.13	.013	1.4	.081	2.7
Na	.21	.001	.92	.083	3.9
K	.26	.003	2.7	.055	6.0
Fe	.52	.051	2.3	.37	2.3
Ti	.10	.022	.44	.063	2.7
		Parts per million			
As	1.9	0.1	26	.9	3.5
B	100	3	150	63	2.4
Ba	300	50	1,500	200	2.1
Be	.7	.07	5	.3	3.6
Cd	.097	.03L	.91	.03	4.9
Cu	9.8	2.9	59	7	2.3
F	180	25	900	110	2.6
Ga	7	.5	50	5	2.9
Ge	1	2	3	1	1.8
Hg	.08	.01L	.98	---	---
La	2	2L	70	5	5.4
Li	14	2.3	140	9.7	2.4
Mn	30	1.5	200	16	3.1
Mo	.7	.3	2	.5	2.6
Nb	3	.7	20	2	3.3
Ni	5	.7	50	2	2.9
P	610	4L	2,300	12	21
Pb	6.9	1	40	3.0	3.7
Sb	.60	.1L	4.5	.27	3.6
Sc	2	.5L	20	1.5	3
Se	1.3	.1L	3.7	1.1	1.8
Sr	100	30	300	100	1.8
Th	3.8	.5	14	2.1	3.0
U	1.5	.1	4.5	.80	3.2
V	20	2	150	10	3.3
Y	7	1.5	50	5	2.6
Yb	.7	2	5	.5	2.7
Zn	15	1.2L	130	6.8	3.5
Zr	50	3	300	20	3.1

Table F8. Proximate and ultimate analyses, forms of sulfur, and heat-of-combustion determinations of 51 coal samples from the Uinta region. [All analyses except heat-of-combustion are in percent. Basis represents form of analyses: 1, as received; 2, moisture free; 3, moisture and ash free.]

Sample #	Lab #	Basis	Moisture	Volatile-Matter	Fixed Carbon	Ash	H	C	N	O	S	Sulfur Forms: Sulfate	Pyritic	Organic	Heat Value: Btu/lb	Kcal/Kg
CATHEDRAL FIELD																
C & K 4-14																
#24	K92142	1	5.3	22.1	26.4	46.2	3.2	37.0	1.1	12.0	0.5	0.01	0.12	0.40	6530	3628
		2		23.4	27.8	48.8	2.7	39.0	1.2	7.7	0.6	0.01	0.13	0.42	6895	3831
		3		45.7	54.3		5.3	76.3	2.3	15.0	1.1	0.01	0.25	0.82	13467	7482
#27	K92140	1	5.8	35.3	42.8	16.1	5.1	62.2	1.7	13.9	1.0	0.01	0.24	0.72	10921	6067
		2		37.5	45.4	17.1	4.7	66.1	1.8	9.3	1.0	0.01	0.25	0.76	11593	6441
		3		45.2	54.8		5.7	79.7	2.2	11.2	1.2	0.01	0.31	0.92	13982	7768
#29	K92139	1	5.1	33.8	38.3	22.8	4.8	57.1	1.7	12.7	0.9	0.01	0.10	0.82	10137	5632
		2		35.7	40.3	24.0	4.4	60.2	1.8	8.6	1.0	0.01	0.11	0.86	10686	5937
		3		46.9	53.1		5.8	79.2	2.4	11.3	1.3	0.01	0.14	1.14	14060	7811
#36	K92141	1	6.2	37.7	45.0	11.1	5.3	65.6	1.7	15.3	0.9	0.01	0.14	0.77	11496	6387
		2		40.2	48.0	11.8	4.9	69.9	1.9	10.4	1.0	0.01	0.15	0.82	12255	6808
		3		45.6	54.4		5.6	79.3	2.1	11.8	1.1	0.01	0.17	0.93	13899	7722
#38	K92143	1	6.3	39.1	50.2	4.4	5.6	71.5	1.8	16.3	0.4	0.01	0.10	0.33	12793	7107
		2		41.7	53.6	4.7	5.2	76.3	1.9	11.4	0.5	0.01	0.11	0.35	13655	7586
		3		43.8	56.2		5.4	80.0	2.0	12.0	0.5	0.01	0.11	0.37	14324	7598
FUELCO 0-28-3-101-S																
Run 3	K90197	1	6.1	39.8	45.5	8.6	5.6	68.2	1.7	14.5	1.4	0.01	0.69	0.66	12215	6786
		2		42.3	48.6	9.1	5.2	72.7	1.8	9.7	1.4	0.01	0.73	0.70	13009	7227
		3		46.6	53.4		5.7	80.0	2.0	10.6	1.6	0.01	0.81	0.77	14313	7952
Run 4	K90196	1	7.2	38.6	49.7	4.5	5.6	71.7	1.8	15.7	0.7	0.01	0.07	0.61	12762	7090
		2		41.6	53.6	4.8	5.2	77.2	1.9	10.0	0.7	0.01	0.08	0.66	13748	7638
		3		43.7	56.3		5.4	81.2	2.0	10.6	0.8	0.01	0.08	0.69	14448	8027
DANFORTH HILLS FIELD																
77-26C-NN																
Core 1	K76536	1	9.1	38.2	48.9	3.8	5.7	69.0	1.5	19.4	0.6				12128	6738
		2		42.1	53.7	4.2	5.2	75.9	1.6	12.5	0.7				13336	7409
		3		43.9	56.1		5.4	79.2	1.7	13.0	0.7				13918	7732
COLOWYO MINE																
Seam Y3		1	19.3	32.9	43.5	4.2					0.4				9843	5468
		2		40.6	53.7	5.2					0.5				12197	6776
		3		42.8	56.6						0.6				12867	7148
Seam Y2		1	17.8	30.6	42.9	8.8					0.4				9662	5368
		2		37.0	51.9	10.6					0.5				11754	6530
		3		41.4	58.0						0.6				13163	7313

Table F8 (cont.).

Sample #	Lab #	Basis	Moisture	Volatile-Matter	Fixed Carbon	Ash	H	C	N	O	S	Sulfur Forms: Sulfate	Sulfur Forms: Pyritic	Sulfur Forms: Organic	Heat Value: Btu/lb	Heat Value: Kcal/K
Seam X		1	15.1	33.1	47.3	4.5					0.3				10725	5958
		2		38.8	55.5	5.3					0.4				12633	7018
		3		41.0	58.6						0.4				13339	7411
Seam A2		1	14.3	33.1	47.2	5.4					0.4				10753	5974
		2		38.4	54.8	6.3					0.5				12547	6971
		3		41.0	58.5						0.5				13391	7439
Seam A1		1	13.8	32.9	45.9	7.4					0.5				10504	5835
		2		37.9	52.9	8.6					0.6				12186	6770
		3		41.5	57.9						0.6				13330	7405
Seam B		1	14.7	32.9	47.8	4.6					0.3				10832	6018
		2		38.4	55.8	5.4					0.4				12699	7055
		3		40.6	59.0						0.4				13423	7457
Seam C		1	14.6	33.2	48.2	4.0					0.4				10907	1059
		2		38.7	56.1	4.7					0.5				12772	7095
		3		40.6	58.9						0.6				13399	7444
Seam D		1	13.8	34.9	45.5	5.8					0.4				10774	5985
		2		40.3	52.5	6.7					0.5				12499	6944
		3		43.2	56.3						0.5				13400	7445
Seam E		1	13.9	34.3	48.2	3.7					0.5				11133	6185
		2		39.6	55.6	4.3					0.5				12930	7183
		3		41.4	58.1						0.5				13511	7506
Seam F		1	14.5	33.7	47.1	4.7					0.4				10832	6018
		2		39.2	54.8	5.5					0.5				12669	7038
		3		41.5	58.0						0.5				13406	7448
D-38-EG																
Run 1	K89044	1	16.3	32.7	47.6	3.4	5.2	62.9	1.3	26.8	0.4	0.01	0.06	0.37	10581	5878
		2		39.0	57.0	4.0	4.1	75.1	1.6	14.7	0.5	0.01	0.07	0.44	12636	7020
		3		40.7	59.3		4.2	78.3	1.7	15.4	0.5	0.01	0.07	0.46	13165	7314
Run 2	K78045	1	15.0	33.7	49.4	1.9	5.1	63.9	1.3	27.4	0.4	.01	0.10	0.24	10986	6103
		2		39.7	58.0	2.3	4.1	75.1	1.6	16.6	0.4	.01	0.12	0.28	12920	7178
		3		40.6	59.4		4.2	76.9	1.6	17.0	0.4	.01	0.12	0.29	13220	7344
Run 3	K89041	1	15.8	33.3	47.6	3.3	5.1	63.1	1.2	26.8	0.4	.01	0.10	0.32	10753	5974
		2		39.5	56.6	3.9	4.0	75.0	1.5	15.1	0.5	.01	0.12	0.38	12772	7096
		3		41.1	58.9		4.2	78.0	1.5	15.8	0.5	.01	0.12	0.40	13295	7386
Run 4	K89043	1	14.3	34.8	45.5	5.3	5.3	62.9	1.1	24.3	1.2	.01	0.14	1.01	10730	5961
		2		40.6	53.3	6.1	4.3	73.4	1.3	13.5	1.4	.01	0.16	1.18	12528	6960
		3		43.3	56.7		4.6	78.2	1.4	14.4	1.4	.01	0.17	1.26	13347	7415

Table F8 (cont.).

Sample #	Lab #	Basis	Moisture	Volatile-Matter	Fixed Carbon	Ash	H	C	N	O	S	Sulfur Forms: Sulfate	Pyritic	Organic	Heat Value: Btu/lb	Kcal/Kg
Run 5	K89046	1	14.6	33.7	48.7	3.0	5.2	64.7	1.2	25.6	0.4	0	0.04	0.32	11013	6118
		2		39.5	57.0	3.5	4.1	75.7	1.4	14.8	0.4	0	0.05	0.37	12897	7165
		3		40.9	59.1		4.3	78.4	1.5	15.3	0.4	0	0.05	0.39	13362	7423
CARBONDALE FIELD VEGA 3																
Core 2	K99779	1	0.7	20.6	61.9	16.8	4.4	73.2	1.7	3.4	0.7				12912	7173
		2		20.7	62.4	16.9	4.3	73.7	1.7	2.8	0.8				13003	7224
		3		24.7	75.1		5.2	88.7	2.0	3.4	0.8				15642	8690
Core 3	K99780	1	1.8	18.8	61.0	18.4	4.2	71.1	1.7	4.0	0.6				12576	6987
		2		19.1	62.2	18.7	4.1	72.4	1.7	2.4	0.6				12808	7116
		3		23.5	76.5		5.1	89.1	2.1	3.0	0.7				15757	8754
SOMERSET FIELD WSC #5																
1A	K92144	1	4.4	39.5	48.2	7.8	5.4	71.7	1.8	12.6	0.8				12690	7050
		2		41.4	50.5	8.1	5.1	75.0	1.9	9.0	0.8				13281	7378
		3		45.0	55.0		5.5	81.6	2.12	9.8	0.9				14453	8024
1B	K94209	1	4.0	36.4	49.0	10.6	5.6	70.0	1.5	11.9	0.5				12418	6899
		2		37.9	51.1	11.0	5.4	72.9	1.6	8.7	0.5				12936	7187
		3		42.6	57.4		6.0	81.9	1.8	9.8	0.6				14539	8077
1C	K95626	1	4.2	38.6	48.4	8.8	5.4	71.2	1.6	12.3	0.7				12656	7031
		2		40.3	50.5	9.2	5.2	74.3	1.6	9.0	0.7				13205	7336
		3		44.3	55.7		5.7	81.8	1.8	9.9	0.8				14537	8076
1D	K95630	1	2.9	43.9	48.5	4.7	5.9	74.9	1.5	10.5	2.5				13567	7537
		2		45.2	50.0	4.8	5.7	77.1	1.6	8.2	2.6				13968	7760
		3		47.5	52.5		6.0	81.0	1.7	8.6	2.7				14673	8152
1-E	K92145	1	3.5	38.2	51.4	6.9	5.4	73.1	1.8	11.5	1.4				13177	7321
		2		39.5	53.3	7.2	5.1	75.7	1.9	8.7	1.4				13649	7583
		3		42.6	57.4		5.5	81.7	2.1	9.4	1.5				14702	8168
1-F	K95971	1	3.8	38.2	55.4	2.6	5.9	77.2	1.8	11.9	0.6				13823	7679
		2		39.7	57.6	2.7	5.7	80.3	1.9	8.8	0.6				14375	7986
		3		40.8	59.2		5.8	82.5	2.0	9.1	0.6				14770	8206
1-G	K95972	1	3.0	40.1	51.9	5.0	5.9	75.2	1.8	11.4	0.7				13637	7576
		2		41.3	53.5	5.2	5.7	77.5	1.8	9.0	0.8				14058	7810
		3		43.6	56.4		6.1	81.7	1.9	9.5	0.8				14823	8235
1-H	K95973	1	3.2	37.7	50.9	8.2	5.6	72.5	1.7	11.3	0.7				13054	7252
		2		39.0	52.6	8.4	5.5	74.9	1.8	8.7	0.7				13484	7491
		3		42.6	57.4		6.0	81.8	2.0	9.6	0.8				14120	8181

Table F8 (cont.).

Sample #	Lab #	Basis	Moisture	Volatile-Matter	Fixed Carbon	Ash	H	C	N	O	S	Sulfur Forms: Sulfate	Pyritic	Organic	Heat Value: Btu/lb	Kcal/Kg
1-I	K95974	1	3.4	36.5	49.2	10.9	5.5	70.5	1.7	10.6	0.8				12621	7012
		2		37.8	50.9	11.3	5.3	73.0	1.7	7.8	0.8				13071	7262
		3		42.6	57.4		6.0	82.2	1.9	8.8	0.9				14732	8184
1-J	K94210	1	1.5	24.9	26.4	47.2	3.7	41.8	0.9	6.1	0.4				7653	4202
		2		25.3	26.8	47.9	3.6	42.5	0.9	4.8	0.4				7769	4316
		3		48.6	51.4		6.8	81.4	1.7	9.3	0.8				14904	8280
78-SMG-106	K99935	1	3.1	35.8	47.0	14.1	5.1	67.6	1.7	10.9	0.6	0.03	0.06	0.57	11986	6659
		2		36.9	48.5	14.6	4.9	69.7	1.8	8.4	0.7	0.03	0.06	0.58	12368	6871
		3		43.2	56.8		5.8	81.6	2.1	9.8	0.8	0.03	0.07	0.68	14477	8043
WSC #6																
CGS 106	K94211	1	3.4	38.6	52.9	5.1	5.9	75.5	1.7	11.1	0.7				13516	7509
		2		40.0	54.7	5.3	5.7	78.1	1.8	8.4	0.8				13986	7770
		3		42.2	57.8		6.0	82.4	1.9	8.9	0.8				14764	8202
CGS 107	K95632	1	3.7	39.4	52.7	4.2	5.8	76.3	1.8	11.4	0.5				13637	7576
		2		40.9	54.8	4.3	5.5	79.3	1.9	8.4	0.5				14161	7867
		3		42.8	57.2		5.8	82.8	2.0	8.8	0.6				14802	8223
C S 108	K95627	1	4.4	36.6	50.4	8.6	5.4	71.5	1.7	12.2	0.5				12774	7097
		2		38.3	52.7	9.0	5.2	74.8	1.7	8.7	0.6				13358	7421
		3		42.1	57.9		5.7	82.2	1.9	9.6	0.6				14683	8157
WSC #7																
CGS 109	K95977	1	3.6	38.1	52.3	6.0	5.7	74.2	1.7	11.6	0.7				13383	7435
		2		39.5	54.2	6.3	5.5	77.0	1.8	8.7	0.8				13880	7711
		3		42.1	57.9		5.8	82.1	1.9	9.3	0.8				14807	8226
CGS 110	K95975	1	2.9	37.2	48.9	11.0	5.6	70.0	1.6	10.7	1.1				12646	7026
		2		38.3	50.4	11.3	5.5	72.1	1.6	8.4	1.1				13024	7236
		3		43.2	56.8		6.1	81.3	1.8	9.4	1.2				14687	8159
CGS 111	K95976	1	3.1	37.8	51.1	8.0	5.8	75.2	1.7	10.7	0.6				13041	7245
		2		39.0	52.7	8.3	5.6	75.5	1.8	8.2	0.6				13459	7477
		3		42.5	57.5		6.1	82.4	1.9	8.9	0.6				14674	8152
WSC #8																
CGS 112	K95625	1	3.5	38.7	52.5	5.3	5.6	75.3	1.6	11.6	0.6				13436	7464
		2		40.1	54.4	5.5	5.4	78.1	1.6	8.8	0.6				13922	7734
		3		42.4	57.6		5.7	82.6	1.7	9.3	0.7				14727	8182
CGS 113	K95628	1	3.6	40.0	48.8	7.6	5.6	73.1	1.6	11.4	0.8				13197	7332
		2		41.5	50.6	7.9	5.4	75.9	1.6	8.5	0.8				13694	7608
		3		45.1	54.9		5.9	82.3	1.8	9.2	0.9				14861	8256

Table F8 (cont.).

Sample #	Lab #	Basis	Moisture	Volatile-Matter	Fixed Carbon	Ash	H	C	N	O	S	Sulfur Forms: Sulfate	Sulfur Forms: Pyritic	Sulfur Forms: Organic	Heat Value: Btu/lb	Heat Value: Kcal/Kg
CGS 114	K95629	1	3.7	37.5	46.3	12.5	5.5	68.5	1.5	11.3	0.7				12253	6807
		2		39.0	48.0	13.0	5.3	71.1	1.5	8.4	0.8				12718	7066
		3		44.8	55.2		6.1	81.7	1.8	9.6	0.8				14616	8120
CGS 115	K95983	1	2.6	41.0	50.2	6.2	5.8	74.9	1.6	9.9	1.7				13689	7605
		2		42.1	51.5	6.4	5.6	76.8	1.6	7.8	1.8				14050	7806
		3		45.0	55.0		6.0	82.1	1.7	8.3	1.9				15005	8336
CGS 116	K94212	1	3.3	40.2	49.7	6.8	5.7	73.7	1.7	11.7	0.4				13272	7373
		2		41.5	51.4	7.1	5.5	76.2	1.7	9.0	0.4				13279	7377
		3		44.7	55.3		5.9	82.0	1.9	9.7	0.5				14774	8208
CGS 117	K95978	1	2.6	40.8	52.6	4.0	5.9	77.5	1.7	9.9	0.9				13868	7704
		2		41.9	54.0	4.1	5.8	79.6	1.8	7.8	0.9				14234	7908
		3		43.7	56.3		6.0	83.0	1.8	8.2	1.0				14844	8247
CGS 118	K95631	1	2.7	39.3	53.6	4.4	5.8	76.8	1.7	10.7	0.5				13827	7682
		2		40.4	55.1	4.5	5.7	78.9	1.8	8.5	0.6				14214	7897
		3		42.3	57.7		6.0	82.6	1.9	8.9	0.6				14883	8268
CGS 119	K95982	1	3.3	34.6	46.9	15.2	5.2	67.1	1.6	10.3	0.5				11975	6653
		2		35.7	48.6	15.7	5.1	69.4	1.6	7.7	0.5				12379	6877
		3		42.4	57.6		6.0	82.3	1.9	9.1	0.6				14690	8161
CGS 120	K95633	1	2.7	36.3	48.5	12.5	5.3	69.7	1.7	10.2	0.6				12600	7000
		2		37.3	49.8	12.9	5.1	71.7	1.7	8.0	0.7				12950	7194
		3		42.8	57.2		5.9	82.2	1.9	9.2	0.8				14862	8257

Section G

Chemical analyses of coal from the Mesaverde Formation Grand Mesa coal field, Delta and Mesa Counties, Colorado

By

Ronald H. Affolter, George P. Eager and Joseph R. Hatch

INTRODUCTION

As part of a continuing program by the U.S. Geological Survey to collect and chemically analyze representative samples of U.S. coals, 45 coal samples were collected from the Upper Cretaceous Mesaverde Formation, Grand Mesa coal field, Delta and Mesa Counties, Colorado. These samples were collected from cores (30 samples, 11 locations), mines (11 face channel samples, 9 locations), and from drill cuttings (4 samples, 1 location).

U.S. Geological Survey sample numbers, index map locations, coal thickness or depth interval sampled, and brief descriptions for the 45 samples are listed in Table G1. Sampling locations are shown in Figure G1. Geophysical logs for all samples summarized in this report can be found in Eager (1978, 1979).

STRATIGRAPHY

The coals of the Grand Mesa coal field occur near the base of the Upper Cretaceous Mesaverde Formation (Lee, 1912), which is equivalent to the Mount Garfield Formation (Erdmann, 1934). The majority of coal beds sampled for this report occur in the Bowie Shale Member of the Mesaverde Formation also called the Cameo coal zone (Erdmann, 1934). This coal zone lies stratigraphically on the Rollins Sandstone Member, a regressive marine deposit. Near the Colorado River, the Palisade coal zone, which lies about 320 stratigraphic feet below the Rollins Sandstone Member was also sampled.

The lowest coals of the Cameo coal zone lie on and pinch-out into the Rollins Sandstone Member and were deposited in near-shore environments, possibly lagoons. Those coals stratigraphically higher and not directly associated with the beach sandstones, were probably deposited in interdistributary delta-plain environments.

EXPLANATION OF TABLES

Proximate and ultimate analyses, heat-of-combustion, air-dried-loss, forms-of-sulfur, free-swelling index, and ash-fusion-temperature determinations on 43 samples from the Grand Mesa coal field are listed in Table G2. These analyses were provided by the U.S. Department of Energy, Pittsburgh, Pa. Analyses for ash content and 39 major and minor oxides and trace elements in the laboratory ash (table G3) and analyses of nine trace elements in whole coal (table G4) for all 45 samples were provided by the U.S. Geological Survey, Denver, Colorado. Analytical procedures used by the U.S. Geological Survey are described in Swanson and Huffman (1976).

Table G5 contains the data listed in table G3 converted to a whole coal basis and the whole-coal analyses listed in table G4. Twenty-three additional elements not listed in tables G3, G4, and G5 were looked for but not found in amounts greater than their lower limits of detection (table G6). Unweighted statistical summaries of the analytical data for 45 coal samples from the Grand Mesa coal field in tables G2, G3, and G4 are listed in tables G7, G8, and G9. For comparison, data summaries for coal samples from the Rocky Mountain Province are included.

Table G1.

U.S. Geological Survey sample numbers, index map location, location, coal thickness or depth interval and sample descriptions for 45 coal samples from the Mesaverde Formation, Grand Mesa coal field, Delta and Mesa Counties, Colorado

[1 foot = 0.305 meters]

USGS sample no.	Index map location	Location	Thickness or depth interval (in feet)	Sample description
		Delta County		
D191607	1	NW 1/4 SW 1/4 sec. 8, T. 13 S., R. 93 W.	4.8	Face channel sample unnamed bed
D194452	2	SE 1/4 SW 1/4 sec. 15, T. 13 S., R. 93 W.	5.5	Do.
D194453	3	SE 1/4 NE 1/4 sec. 22, T. 13 S., R. 93 W.	5.3	Do.
D194454	4	SE 1/4 SW 1/4 sec. 12, T. 13 S., R. 95 W.	5.7	Do.
D194455	5	NW 1/4 NE 1/4 sec. 13, T. 13 S., R. 95 W.	4.4	Do.
D194456	6	SE 1/4 NE 1/4 sec. 15, T. 13 S., R. 94 W.	1.8	Do.
D194457	7	NW 1/4 SW 1/4 sec. 27, T. 13 S., R. 92 W.	5.1	Do.
D203116	8	NE 1/4 SE 1/4 sec. 20, T. 13 S., R, 92 W.	1007.8-1011.3	Core Sample unnamed bed
D203117	8	----------do----------	1029.3-1038.3	Do.
D103118	8	----------do----------	1168.0-1173.7	Do.
D203119	8	----------do----------	1218.2-1228.0	Do.
D203113	10	SE 1/4 SW 1/4 sec. 19, T. 13 S., R. 92 W.	797.8- 804.1	Do.
D203114	10	----------do----------	881.7- 893.0	Do.
D203115	10	----------do----------	893.0- 900.1	Do.
D203120	11	NW 1/4 SW 1/4 sec. 24, T. 13 S., R. 93 W.	986.1- 998.9	Do.
D203109	12	NE 1/4 NW 1/4 sec. 8, T. 13 S., R. 93 W.	161.4- 168.2	Do.
D203110	12	----------do----------	192.7- 202.1	Do.
D203111	12	----------do----------	202.3- 206.4	Do.
D203112	12	----------do----------	237.3- 245.0	Do.
D203106	13	SW 1/4 NE 1/4 sec. 1, T. 13 S., R. 94 W.	838.0- 845.0	Do.
D203107	13	----------do----------	857.7- 865.1	Do.
D203108	13	----------do----------	883.2- 892.6	Do.
D203100	14	NE 1/4 NE 1/4 sec. 15, T. 13 S. R. 94 W.	82.0- 91.0	Drill cuttings unnamed bed
D203102	14	----------do----------	145.0- 155.0	Do.
D203103	14	----------do----------	169.0- 175.0	Do.
D203105	14	----------do----------	234.0- 240.0	Do.
D203095	15	NE 1/4 NE 1/4 sec. 8, T. 13 S., R. 95 W.	703.1- 714.2	Core sample unnamed bed
D203096	16	SW 1/4 NW 1/4 sec. 25, T. 13 S., R. 96 W.	178.7- 187.0	Do.
D203098	16	----------do----------	187.0- 190.2	Do.
D203099	16	----------do----------	210.0- 211.6	Do.
D203091	17	SE 1/4 NW 1/4 sec. 24, T. 13 S., R. 96 W.	505.5- 511.2	Do.
D203092	17	----------do----------	553.3- 564.3	Do.
D203093	17	----------do----------	564.8- 569.0	Do.
D203094	17	----------do----------	581.0- 584.0	Do.
D203089	22	SW 1/4 NE 1/4 sec. 32, T. 13 S., R. 96 W.	983.0- 986.5	Do.
D203090	22	----------do----------	1001.1-1007.0	Do.
		Mesa County		
D180095	22	SE 1/4 SE 1/4 sec. 34, T. 10 S., R. 98 W.	upper 4.0	Face channel sample unnamed bed
D180096	22	----------do----------	lower 3.75	Do.
D184655	19	NW 1/4 SE 1/4 sec. 34, T. 10 S., R. 98 W.	upper 3.0	Do.
D184656	19	----------do----------	lower 3.0	Do.
D203087	20	SE 1/4 NW 1/4 sec. 21, T. 12 S., R. 97 W.	528.8- 535.1	Core sample unnamed bed
D203088	20	----------do----------	540.9- 547.2	Do.
D203083	21	SW 1/4 SE 1/4 sec. 13, T. 10 S., R. 98 W.	868.4- 814.7	Do.
D203084	21	----------do----------	863.0- 862.0	Do.
D203086	21	----------do----------	1287.3-1290.8	Do.

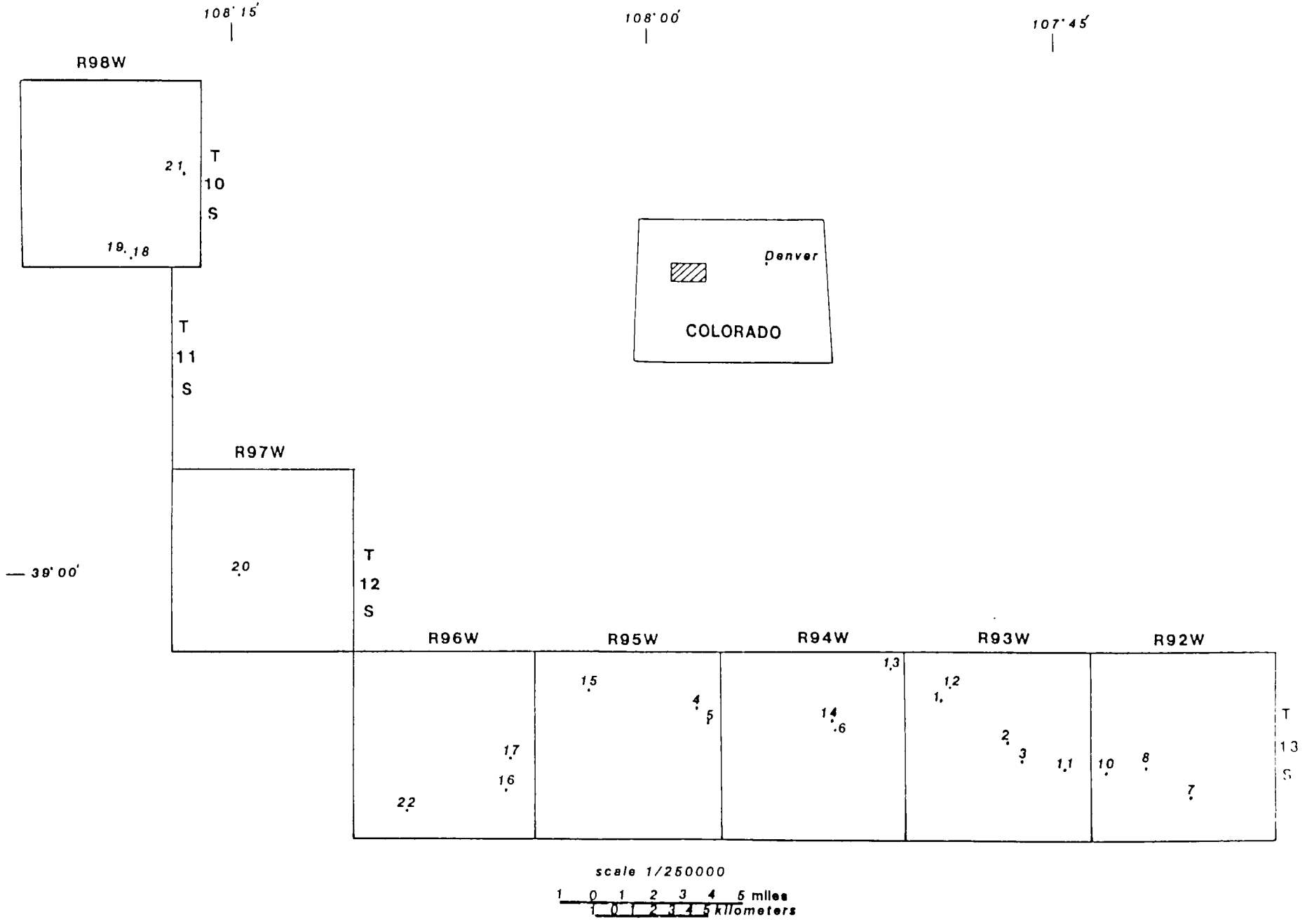


Figure G-1. Index map showing the location of sample sites from the Grand Mesa coal field, Delta and Mesa Counties, Colorado.

Arsenic contents of the samples summarized in this report have been determined by two different analytical methods. Samples D180095 and D180096 were analyzed by the graphite furnace-atomic absorption method (lower detection limit 0.5 ppm). The remaining 43 samples were analyzed by instrumental neutron activation analysis (lower detection limit 0.1 ppm).

Thorium contents of the samples were determined by two methods. Samples D180095 and D180096 were analyzed by delayed neutron activation analysis (lower detection limit 3.0 ppm). The remaining 43 samples were analyzed by instrumental neutron activation analysis (lower detection limit 0.1 ppm). The P_2O_5 contents for all samples were determined by X-ray fluorescence spectroscopy. However, due to changes in technique, the lower detection limit for samples D1800950-D180096, D184655-D184656, D191607, and D194452-D194457, was 1.0 percent in coal ash, and for the remaining 34 samples it was 0.01 percent in whole coal.

To be consistent with the precision of the semiquantitative emission spectrographic tecnniques, arithmetic and geometric means of elements determined by this method are reported as the midpoints of the enclosing six step brackets (see subtitle of table G3, or Swanson and Huffman, 1976, p. 6 for an explanation of six step brackets).

DISCUSSION

The apparent ranks of all 43 coal samples from the Grand Mesa coal field, Delta and Mesa Counties, Colorado were calculated using the data in table 2 and the formulas in ASTM designation D-388-77 (American Society for Testing and Materials, 1978). The apparent ranks range from subbituminous B coal to high-volatile A bituminous coal: eight samples have an apparent rank of subbituminous B coal; 8 samples, subbituminous A coal; 22 samples, high-volatile C bituminous coal, 2 samples, high-volatile B bituminous coal, and 3 samples, high volatile A bituminous coal.

STRUCTURE AND COAL RANK

The coal dips gently to north or northeast into the Piceance Creek basin. Apparent coal ranks of samples from the western part of the coal field varies linearly from subbituminous B to high-volatile A bituminous through the 7,700 foot (D203089) to 3,550 foot (D203086) elevation range sampled (fig. G2). The relationship of coal rank to elevation in the western Grand Mesa coal field is probably a reflection of original burial depth within the Piceance Creek basin. Freeman (1979) has shown similar trends in the deeper parts of the basin.

A statistical comparison (student's t-test, 95-percent confidence level) of tne geometric mean contents of the U.S. Department of Energy's data for 43 coal samples from tne Grand Mesa coal field with 86 coal samples from the Rocky Mountain Province shows that coal from the Grand Mesa coal field has significantly higher contents of asn, nitrogen, total sulfur, and organic sulfur and significantly lower contents of volatile matter and sulfate sulfur. The heat of combustion and the contents of moisture, fixed carbon, hydrogen, carbon, oxygen, and pyritic sulfur are not significantly different.

A statistical comparison of the geometric mean contents of coal ash and the geometric mean contents of nine major and minor oxides in the ash for 45 coal samples from the Grand Mesa coal field with 295 coal samples from the Rocky Mountain Province shows that coal ash from the Grand Mesa coal field has significantly higher contents of SiO_2, Al_2O_3, Na_2O and TiO_2, and significantly lower contents CaO, MgO, and SO_3. The contents of ash and K_2O and Fe_2O_3 contents in ash are not significantly different. When compared at the 99-percent confidence level the content of SiO_2 is not significantly different.

A statistical comparison of the geometric mean contents of 36 elements in 45 coal samples from the Grand Mesa coal field with 295 coal samples from the Rocky Mountain Province shows that coal from tne Grand Mesa coal field has significantly higher contents of Al, Na, Ti, B, Be, Ga, Li, Nb, Pb, Sb, Zn, and Zr, and significantly lower contents of Ca, Mg, As, Cd, Cr, Hg, Mo, and V. The contents of Si, K, Fe, Ba, Co, Cu, F, Mn, Ni, Sc, Se, Sr, Th, U, Y, and Yb are not significantly different. When compared at the 99-percent confidence level the contents of Be and Sb are not significantly different. The contents of P, Ge, and La could not be statistically compared due to lack of this information for Rocky Mountain Province coals.

Differences in the oxide composition of coal ashes and the elemental contents of coal result from differences in the total and relative amounts of the various inorganic minerals, the elemental composition of these minerals, and the total and relative amounts of any organically bound elements. The chemical form and distribution of a given element are dependent on the geologic history of the coal bed. A partial listing of the factors that influence element distributions would include chemical composition of original plants; amounts and composition of the various detrital, diagenetic, and epigenetic minerals; chemical characteristics of the ground waters that come in contact with the bed; temperatures and pressures during burial; and extent of weathering. No evaluation of these factors has been made for coal from the Grand Mesa coal field.

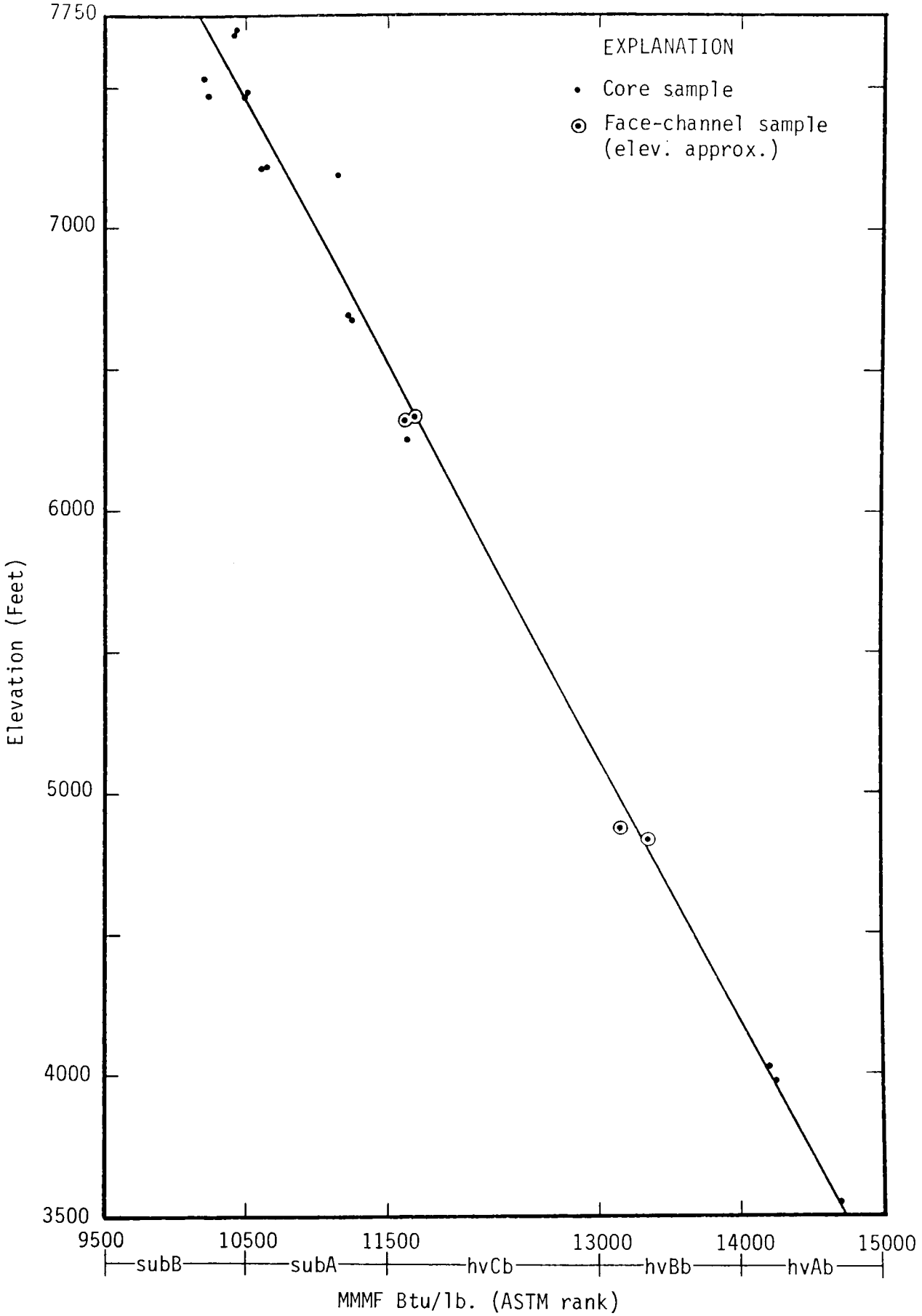


Figure G2. Relationship of coal elevation and coal rank in the western Grand Mesa coal field.

Acknowledgments

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Table G2.

Proximate and ultimate analyses, and heat-of-combustion, forms-of-sulfur, free-swelling-index and ash-fusion-temperature determinations for 43 coal samples from the Mesaverde Formation, Grand Mesa coal field, Delta and Mesa Counties, Colorado

[All analyses except heat of combustion, free-swelling index, and ash-fusion temperatures in percent. For each sample number, the analyses are reported three ways: first, as received; second, moisture free; and third, moisture and ash free. All analyses by Coal Analyses Section, U.S. Department of Energy, Pittsburgh, Pa. Kcal/kg = 0.556 (Btu/lb); $^{o}F = (^{o}C \times 1.8) + 32$; L, less than the value shown, B, not determined.]

Sample number	Proximate analysis				Ultimate analysis					Heat of Combustion	
	Moisture	Volatile matter	Fixed carbon	Ash	Hydrogen	Carbon	Nitrogen	Oxygen	Sulfur	Kcal/kg	Btu/lb
D191607	11.2	31.1	39.0	18.7	5.1	52.9	1.2	21.5	0.6	5,170	9,310
	---	35.0	43.9	21.1	4.3	59.6	1.4	13.0	.7	5,820	10,480
	---	44.4	55.6	---	5.5	75.5	1.7	16.5	.9	7,380	13,280
D194452	13.5	34.0	42.0	10.5	5.8	59.0	1.4	22.6	.7	5,700	10,260
	---	39.3	48.6	12.1	5.0	68.2	1.6	12.3	.8	6,590	11,860
	---	44.7	55.3	---	5.7	77.6	1.8	13.9	.9	7,500	13,500
D194453	12.6	33.1	42.6	11.7	5.4	56.3	1.4	24.5	.8	5,450	9,820
	---	37.9	48.7	13.4	4.6	64.4	1.6	15.2	.9	6,240	11,230
	---	43.7	56.3	---	5.3	74.4	1.8	17.6	1.1	7,210	12,970
D194454	11.9	34.9	44.8	8.4	5.7	61.1	1.4	22.1	1.4	5,900	10,620
	---	39.6	50.9	9.5	5.0	69.4	1.6	13.1	1.6	6,700	12,060
	---	43.8	56.2	---	5.5	76.7	1.8	14.5	1.8	7,400	13,330
D194455	11.2	34.3	45.8	8.7	5.6	60.0	.8	23.8	1.1	5,850	10,520
	---	38.6	51.6	9.8	4.9	67.6	.9	15.6	1.2	6,580	11,850
	---	42.8	57.2	---	5.4	74.9	1.0	17.3	1.4	7,300	13,140
D194456	8.9	35.6	40.9	14.6	5.3	56.5	1.3	21.1	1.1	5,490	9,880
	---	39.1	44.9	16.0	4.7	62.0	1.4	14.5	1.2	6,030	10,850
	---	46.5	53.5	---	5.6	73.9	1.7	17.2	1.4	7,180	12,920
D194457	10.5	35.6	44.5	9.4	5.6	60.9	1.4	21.9	.8	6,030	10,850
	---	39.8	49.7	10.5	5.0	68.0	1.6	14.0	.9	6,740	12,130
	---	44.4	55.6	---	5.5	76.0	1.7	15.7	1.0	7,530	13,550
D203116	13.6	34.6	48.6	3.2	6.1	64.6	1.6	24.1	.5	6,300	11,340
	---	40.0	56.2	3.7	5.3	74.8	1.9	13.9	.6	7,290	13,120
	---	41.6	58.4	---	5.5	77.6	1.9	14.4	.6	7,570	13,620
D203117	13.3	36.8	43.7	6.2	5.8	62.3	1.5	23.8	.4	6,100	10,990
	---	42.4	50.4	7.2	5.0	71.9	1.7	13.8	.5	7,040	12,670
	---	45.7	54.3	---	5.4	77.4	1.9	14.9	.5	7,580	13,650
D203118	10.4	35.2	45.6	8.8	5.9	62.7	1.5	20.7	.6	6,150	11,070
	---	39.3	50.9	9.8	5.3	70.0	1.7	12.8	.7	6,860	12,360
	---	43.6	56.4	---	5.9	77.6	1.9	14.2	.7	7,610	13,700
D203119	11.0	33.1	46.2	9.7	5.7	61.6	1.4	21.1	.6	6,050	10,890
	---	37.2	51.9	10.9	5.0	69.2	1.6	12.7	.7	6,800	12,230
	---	41.7	58.3	---	5.6	77.7	1.8	14.3	.8	7,630	13,730

Table G2. (cont.)

Proximate and ultimate analyses, and heat-of-combustion, forms-of-sulfur, free-swelling-index and ash-fusion-temperature determinations for 43 coal samples from the Mesaverde Formation, Grand Mesa coal field, Delta and Mesa Counties, Colorado --continued

Sample number	Air-dried loss	Forms of sulfur			Free swelling	Ash fusion temperature, °C		
		Sulfate	Pyritic	Organic		Initial deformation	Softening	Fluid
D191607	2.6	0.03	0.02	0.55	0.0	1,600	1,600	1,600
	---	.03	.02	.62				
	---	.04	.03	.78				
D194452	7.6	.02	.13	.52	.0	1,490	1,540	1,540
	---	.02	.15	.60				
	---	.03	.17	.68				
D194453	6.2	.02	.28	.47	.0	1,540	1,540	1,540
	---	.02	.32	.54				
	---	.03	.37	.62				
D194454	5.8	.02	.09	1.26	.0	1,540	1,540	1,540
	---	.02	.10	1.43				
	---	.03	.11	1.58				
D194455	5.2	.02	.11	.94	.0	1,540	1,540	1,540
	---	.02	.12	1.06				
	---	.02	.14	1.17				
D194456	3.6	.01	.20	.91	.0	1,540	1,540	1,540
	---	.01	.22	1.00				
	---	.01	.26	1.19				
D194457	4.7	.01	.08	.67	.0	1,540	1,540	1,540
	---	.01	.09	.75				
	---	.01	.10	.84				
D203116	8.8	.01	.03	.42	.0	1,150	1,210	1,260
	---	.01	.03	.49				
	---	.01	.04	.50				
D203117	9.0	.01	.05	.38	.0	1,375	1,440	1,490
	---	.01	.06	.44				
	---	.01	.06	.47				
D203118	6.6	.01	.05	.53	.0	1,600+	1,600+	1,600+
	---	.01	.06	.59				
	---	.01	.06	.66				
D203119	7.0	.01	.09	.54	.0	1,600+	1,600+	1,600+
	---	.01	.10	.61				
	---	.01	.11	.68				

Table G2. (cont.)

Proximate and ultimate analyses, and heat-of-combustion, forms-of-sulfur, free-swelling-index and ash-fusion-temperature determinations for 43 coal samples from the Mesaverde Formation, Grand Mesa coal field, Delta and Mesa Counties, Colorado --continued

Sample number	Proximate analysis				Ultimate analysis					Heat of Combustion	
	Moisture	Volatile matter	Fixed carbon	Ash	Hydrogen	Carbon	Nitrogen	Oxygen	Sulfur	Kcal/kg	Btu/lb
D203113	15.1	35.3	46.1	3.5	6.2	62.9	1.5	25.5	0.5	6,180	11,130
	---	41.6	54.3	4.1	5.3	74.1	1.8	14.2	.6	7,280	13,100
	---	43.4	56.6	---	5.6	77.3	1.8	14.8	.6	7,590	13,670
D203114	14.1	32.5	43.9	9.5	5.9	58.8	1.3	23.9	.5	5,750	10,360
	---	37.8	51.1	11.1	5.0	68.5	1.5	13.2	.6	6,700	12,060
	---	42.5	57.5	---	5.7	77.0	1.7	14.9	.7	7,530	13,550
D203115	13.9	32.3	42.6	11.2	5.8	57.6	1.3	23.7	.4	5,610	10,110
	---	37.5	49.5	13.0	4.9	66.9	1.5	13.2	.5	6,520	11,740
	---	43.1	56.9	---	5.7	76.9	1.7	15.1	.5	7,500	13,490
D203120	10.1	33.6	44.9	11.4	5.5	59.7	1.4	21.5	.5	5,830	10,490
	---	37.4	49.9	12.7	4.9	66.4	1.6	13.9	.6	6,480	11,660
	---	42.8	57.2	---	5.6	76.1	1.8	16.0	.6	7,420	13,360
D203109	13.1	36.4	44.8	5.7	6.0	63.5	1.5	22.8	.6	6,230	11,210
	---	41.9	51.6	6.6	5.2	73.1	1.7	12.8	.7	7,160	12,900
	---	44.8	55.2	---	5.6	78.2	1.8	13.7	.7	7,670	13,800
D203110	12.8	37.7	44.0	5.5	6.1	64.0	1.3	22.8	.4	6,320	11,370
	---	43.2	50.5	6.3	5.4	73.4	1.5	13.1	.5	7,240	13,040
	---	46.1	53.9	---	5.7	78.3	1.6	14.0	.5	7,730	13,920
D203111	12.2	35.8	43.0	9.0	5.8	61.6	1.4	21.7	.5	6,060	10,920
	---	40.8	49.0	10.3	5.1	70.2	1.6	12.4	.6	6,910	12,430
	---	45.4	54.6	---	5.6	78.2	1.8	13.8	.6	7,700	13,850
D203112	11.8	36.3	42.6	9.3	5.7	61.5	1.4	21.5	.6	6,060	10,910
	---	41.2	48.3	10.5	5.0	69.7	1.6	12.5	.7	6,870	12,370
	---	46.0	54.0	---	5.6	77.9	1.8	14.0	.8	7,680	13,830
D203106	12.1	34.3	47.9	5.7	6.1	64.4	1.5	21.8	.5	6,340	11,410
	---	39.0	54.5	6.5	5.4	73.3	1.7	12.6	.6	7,210	12,990
	---	41.7	58.3	---	5.8	78.3	1.8	13.4	.6	7,710	13,890
D203107	12.4	37.2	43.0	7.4	5.8	62.7	1.4	22.1	.6	6,120	11,020
	---	42.5	49.1	8.4	5.0	71.6	1.6	12.6	.7	6,990	12,580
	---	46.4	53.6	---	5.5	78.2	1.7	13.8	.7	7,630	13,740
D203108	11.5	37.0	42.0	9.5	5.8	61.6	1.4	21.2	.6	6,090	10,970
	---	41.8	47.5	10.7	5.1	69.6	1.6	12.4	.7	6,890	12,390
	---	46.8	53.2	---	5.7	78.0	1.8	13.9	.8	7,710	13,880
D203100	14.2	31.5	39.5	14.8	5.5	54.2	1.2	23.6	.6	5,300	9,540
	---	36.7	46.0	17.2	4.6	63.2	1.4	12.8	.7	6,180	11,120
	---	44.4	55.6	---	5.5	76.3	1.7	15.5	.8	7,460	13,430

Table G2. (cont.)

Proximate and ultimate analyses, and heat-of-combustion, forms-of-sulfur, free-swelling-index and ash-fusion-temperature determinations for 43 coal samples from the Mesaverde Formation, Grand Mesa coal field, Delta and Mesa Counties, Colorado --continued

Sample number	Air-dried loss	Forms of sulfur			Free swelling	Ash fusion temperature, °C		
		Sulfate	Pyritic	Organic		Initial deformation	Softening	Fluid
D203113	11.0	0.01	0.04	0.42	0.0	1,155	1,205	1,265
	---	.01	.05	.49				
	---	.01	.05	.52				
D203114	10.3	.01	.04	.49	.0	1,515	1,600+	1,600+
	---	.01	.05	.57				
	---	.01	.05	.64				
D203115	10.2	.01	.04	.40	.0	1,600+	1,600+	1,600+
	---	.01	.05	.46				
	---	.01	.05	.53				
D203120	6.3	.01	.05	.42	.0	1,600+	1,600+	1,600+
	---	.01	.06	.47				
	---	.01	.06	.54				
D203109	9.0	.01	.10	.45	.0	1,270	1,320	1,380
	---	.01	.12	.52				
	---	.01	.12	.55				
D203110	8.7	.01	.04	.35	1.0	1,600+	1,600+	1,600+
	---	.01	.05	.40				
	---	.01	.05	.43				
D203111	8.1	.01	.04	.48	.0	1,600+	1,600+	1,600+
	---	.01	.05	.55				
	---	.01	.05	.61				
D203112	7.6	.01	.05	.51	.0	1,600+	1,600+	1,600+
	---	.01	.06	.58				
	---	.01	.06	.65				
D203106	7.9	.01	.06	.42	.0	1,600+	1,600+	1,600+
	---	.01	.07	.48				
	---	.01	.07	.51				
D203107	8.2	.01	.05	.53	.0	1,600+	1,600+	1,600+
	---	.01	.06	.61				
	---	.01	.06	.66				
D203108	6.9	.01	.04	.54	1.0	1,600+	1,600+	1,600+
	---	.01	.05	.61				
	---	.01	.05	.68				
D203100	8.1	.01	.03	.65	.0	1,345	1,400	1,455
	---	.01	.03	.76				
	---	.01	.04	.92				

Table G2. (cont.)

Proximate and ultimate analyses, and heat-of-combustion, forms-of-sulfur, free-swelling-index and ash-fusion-temperature determinations for 43 coal samples from the Mesaverde Formation, Grand Mesa coal field, Delta and Mesa Counties, Colorado --continued

Sample number	Proximate analysis				Ultimate analysis					Heat of Combustion	
	Moisture	Volatile matter	Fixed carbon	Ash	Hydrogen	Carbon	Nitrogen	Oxygen	Sulfur	Kcal/kg	Btu/lb
D203102	14.8	30.2	38.3	16.7	5.3	52.6	1.2	23.9	0.4	5,120	9,220
	---	35.4	45.0	19.6	4.3	61.7	1.4	12.6	.5	6,010	10,820
	---	44.1	55.9	---	5.3	76.8	1.8	15.7	.6	7,470	13,450
D203103	11.1	22.9	24.6	41.4	4.1	35.7	.8	17.5	.5	3,440	6,200
	---	25.8	27.7	46.6	3.2	40.2	.9	8.6	.6	3,870	6,970
	---	48.2	51.8	---	6.0	75.2	1.7	16.1	1.1	7,250	13,040
D203105	14.7	28.7	38.6	18.0	5.4	51.2	1.1	23.6	.6	4,990	8,990
	---	33.6	45.3	21.1	4.4	60.0	1.3	12.3	.7	5,850	10,530
	---	42.6	57.4	---	5.6	76.1	1.6	15.7	.9	7,420	13,350
D203095	13.8	31.4	45.1	9.7	5.5	59.1	1.4	23.7	.6	5,790	10,420
	---	36.4	52.3	11.3	4.6	68.6	1.6	13.3	.7	6,710	12,080
	---	41.0	59.0	---	5.2	77.3	1.8	14.9	.8	7,560	13,620
D203096	19.2	31.3	41.0	8.5	6.1	55.2	1.3	28.3	.6	5,380	9,680
	---	38.7	50.7	10.5	4.9	68.3	1.6	13.9	.7	6,660	11,990
	---	43.3	56.7	---	5.5	76.3	1.8	15.5	.8	7,440	13,400
D203098	18.9	32.3	37.9	10.9	6.0	53.3	1.3	27.7	.8	5,200	9,370
	---	39.8	46.7	13.4	4.8	65.7	1.6	13.4	1.0	6,420	11,550
	---	46.0	54.0	---	5.6	75.9	1.9	15.5	1.1	7,410	13,340
D203099	16.6	33.8	41.3	8.3	5.9	57.2	1.3	25.6	1.6	5,630	10,140
	---	40.5	49.5	10.0	4.9	68.6	1.6	13.0	1.9	6,750	12,160
	---	45.0	55.0	---	5.4	76.2	1.7	14.4	2.1	7,500	13,500
D203091	18.8	30.4	33.5	17.3	5.4	47.8	1.1	27.4	1.0	4,610	8,300
	---	37.4	41.3	21.3	4.1	58.9	1.4	13.2	1.2	5,680	10,220
	---	47.6	52.4	---	5.2	74.8	1.7	16.7	1.6	7,210	12,990
D203092	19.5	31.6	38.5	10.4	6.0	53.1	1.2	28.3	1.0	5,180	9,320
	---	39.3	47.8	12.9	4.8	66.0	1.5	13.6	1.2	6,430	11,580
	---	45.1	54.9	---	5.5	75.7	1.7	15.6	1.4	7,390	13,290
D203093	19.6	31.2	34.0	15.2	5.7	48.8	1.1	28.7	.6	4,750	8,550
	---	38.8	42.3	18.9	4.4	60.7	1.4	14.0	.7	5,910	10,640
	---	47.9	52.1	---	5.4	74.8	1.7	17.3	.9	7,290	13,120
D203094	20.2	30.7	39.7	9.4	6.1	53.3	1.1	28.9	1.2	5,240	9,420
	---	38.5	49.7	11.8	4.8	66.8	1.4	13.7	1.5	6,560	11,810
	---	43.6	56.4	---	5.5	75.7	1.6	15.5	1.7	7,440	13,390
D203089	19.1	30.4	39.7	10.8	5.8	53.0	1.2	28.7	.5	5,120	9,220
	---	37.6	49.1	13.3	4.5	65.5	1.5	14.5	.6	6,330	11,400
	---	43.4	56.6	---	5.2	75.6	1.7	16.7	.7	7,310	13,150

Table G2. (cont.)

Proximate and ultimate analyses, and heat-of-combustion, forms-of-sulfur, free-swelling-index and ash-fusion-temperature determinations for 43 coal samples from the Mesaverde Formation, Grand Mesa coal field, Delta and Mesa Counties, Colorado --continued

Sample number	Air-dried loss	Forms of sulfur			Free swelling	Ash fusion temperature, °C		
		Sulfate	Pyritic	Organic		Initial deformation	Softening	Fluid
D203102	8.8	0.01	0.03	0.35	0.0	1,290	1,345	1,400
	---	.01	.04	.41				
	---	.01	.04	.51				
D203103	8.9	.01	.14	.38	.0	1,375	1,440	1,495
	---	.01	.16	.43				
	---	.02	.29	.80				
D203105	11.8	.01	.12	.44	.0	1,600+	1,600+	1,600+
	---	.01	.14	.52				
	---	.01	.18	.65				
D203095	7.6	.01	.03	.58	.0	1,600+	1,600+	1,600+
	---	.01	.03	.67				
	---	.01	.04	.76				
D203096	11.5	.01	.04	.51	.0	1,600+	1,600+	1,600+
	---	.01	.05	.63				
	---	.01	.06	.71				
D203098	11.6	.01	.03	.75	.0	1,600+	1,600+	1,600+
	---	.01	.04	.92				
	---	.01	.04	1.07				
D203099	9.5	.01	.94	.62	.0	1,125	1,180	1,230
	---	.01	1.13	.74				
	---	.01	1.25	.83				
D203091	10.9	.01	.03	.94	.0	1,320	1,380	1,435
	---	.01	.04	1.16				
	---	.02	.05	1.47				
D203092	11.6	.01	.09	.91	.0	1,235	1,290	1,345
	---	.01	.11	1.13				
	---	.01	.13	1.30				
D203093	12.2	.01	.05	.54	.0	1,600+	1,600+	1,600+
	---	.01	.06	.67				
	---	.02	.08	.83				
D203094	13.5	.01	.05	1.12	.0	1,205	1,265	1,325
	---	.01	.06	1.40				
	---	.01	.07	1.59				
D203089	11.2	.01	.04	.49	.0	1,345	1,400	1,450
	---	.01	.05	.61				
	---	.01	.06	.70				

Table G2. (cont.)

Proximate and ultimate analyses, and heat-of-combustion, forms-of-sulfur, free-swelling-index and ash-fusion-temperature determinations for 43 coal samples from the Mesaverde Formation, Grand Mesa coal field, Delta and Mesa Counties, Colorado --continued

Sample number	Proximate analysis				Ultimate analysis					Heat of Combustion	
	Moisture	Volatile matter	Fixed carbon	Ash	Hydrogen	Carbon	Nitrogen	Oxygen	Sulfur	Kcal/kg	Btu/lb
D203090	19.4	31.2	38.3	11.1	5.9	52.3	1.3	28.7	0.8	5,090	9,160
	---	38.7	47.5	13.8	4.6	64.9	1.6	14.2	1.0	6,320	11,370
	---	44.9	55.1	---	5.4	75.3	1.9	16.5	1.2	7,330	13,190
D180095	5.1	29.8	41.8	23.3	4.5	56.0	1.2	13.9	1.2	5,460	9,830
	---	31.4	44.0	24.6	4.1	59.0	1.3	9.9	1.3	5,760	10,360
	---	41.6	58.4	---	5.5	78.2	1.7	13.1	1.7	7,630	13,730
D184655	5.5	35.4	47.3	11.8	5.0	66.1	1.5	15.0	.6	6,470	11,650
	---	37.5	50.1	12.5	4.6	69.9	1.6	10.7	.6	6,850	12,330
	---	42.8	57.2	---	5.3	79.9	1.8	12.2	.7	7,830	14,090
D203087	15.3	35.9	38.6	10.2	5.9	57.8	1.2	24.3	.5	5,540	9,970
	---	42.4	45.6	12.0	5.0	68.2	1.4	12.6	.6	6,540	11,780
	---	48.2	51.8	---	5.6	77.6	1.6	14.4	.7	7,440	13,390
D203088	14.2	31.7	36.2	17.9	5.6	51.9	1.2	22.8	.6	5,030	9,060
	---	36.9	42.2	20.9	4.7	60.5	1.4	11.9	.7	5,870	10,560
	---	46.7	53.3	---	5.9	76.4	1.8	15.0	.9	7,410	13,340
D203083	3.5	35.4	46.4	14.7	5.4	66.6	1.5	11.1	.8	6,630	11,930
	---	36.7	48.1	15.2	5.2	69.0	1.6	8.3	.8	6,870	12,360
	---	43.3	56.7	---	6.1	81.4	1.8	9.8	1.0	8,100	14,590
D203084	3.0	34.5	47.5	15.0	5.4	66.8	1.4	10.5	.9	6,630	11,940
	---	35.6	49.0	15.5	5.2	68.9	1.4	8.1	.9	6,840	12,310
	---	42.1	57.9	---	6.2	81.5	1.7	9.6	1.1	8,090	14,560
D203086	2.5	38.7	51.5	7.3	5.7	74.2	1.8	8.7	2.2	7,490	13,490
	---	39.7	52.8	7.5	5.6	76.1	1.8	6.6	2.3	7,690	13,830
	---	42.9	57.1	---	6.0	82.3	2.0	7.2	2.4	8,310	14,950

Table G2. (cont.)

Proximate and ultimate analyses, and heat-of-combustion, forms-of-sulfur, free-swelling-index and ash-fusion-temperature determinations for 43 coal samples from the Mesaverde Formation, Grand Mesa coal field, Delta and Mesa Counties, Colorado --continued

Sample number	Air-dried loss	Forms of sulfur			Free swelling	Ash fusion temperature, °C		
		Sulfate	Pyritic	Organic		Initial deformation	Softening	Fluid
D203090	11.7	0.01	0.05	0.71	0.0	1,235	1,290	1,345
	---	.01	.06	.88				
	---	.01	.07	1.02				
D180095	1.6	.06	.57	.53	1.0	1,400	1,445	1,495
	---	.06	.60	.56				
	---	.08	.80	.74				
D184655	1.6	.01L	.04	.54	1.0	1,350	1,405	1,465
	---	.01L	.04	.57				
	---	.01L	.05	.65				
D203087	9.2	.01	.15	.34	.0	1,180	1,235	1,290
	---	.01	.18	.40				
	---	.01	.20	.46				
D203088	8.3	.01	.29	.34	.0	1,375	1,435	1,490
	---	.01	.34	.40				
	---	.01	.43	.50				
D203083	.9	.01	.15	.60	3.0	1,480	1,540	1,595
	---	.01	.16	.62				
	---	.01	.18	.73				
D203084	.6	.01	.39	.52	2.5	1,600+	1,600+	1,600+
	---	.01	.40	.54				
	---	.01	.48	.63				
D203086	.4	.02	1.55	.59	5.0	1,155	1,205	1,270
	---	.02	1.59	.61				
	---	.02	1.72	.65				

Table G3.

Major- and minor-oxide and trace element composition of the laboratory ash of 45 coal samples from the Mesaverde Formation, Grand Mesa coal field, Delta and Mesa Counties, Colorado

[Values in percent or parts per million. Coal ashed at 525° C. L, less than the value shown; N not detected; B, not determined. S after element title indicates determinations by semiquantitative emission spectrography. The spectrographic results are to be identified with geometric brackets whose boundaries are part of the ascending series 0.12, 0.18, 0.26, 0.38, 0.56, 0.83, 1.2, etc. but reported as midpoints of the brackets, 0.1, 0.15, 0.2, 0.3, 0.5, 0.7, 1.0, etc. Precision of the spectrographic data is plus-or-minus one bracket at 68 percent or plus-or-minus two brackets at 95 percent confidence level]

Sample number	Ash (percent)	SiO2 (percent)	Al2O3 (percent)	CaO (percent)	MgO (percent)	Na2O (percent)	K2O (percent)	Fe2O3 (percent)	TiO2 (percent)	P2O5 (percent)	Sample number
D191607	19.8	55	34	2.2	0.63	0.86	0.89	0.60	1.1	1.0L	D191607
D194452	12.2	51	30	2.3	2.86	.30	.40	5.8	1.2	1.0L	D194452
D194453	13.6	49	30	1.9	3.00	.70	.50	7.1	1.0	1.0L	D194453
D194454	9.8	52	35	1.9	1.89	.36	.30	1.5	1.3	1.0L	D194454
D194455	9.7	50	34	1.5	2.17	.46	.40	3.2	1.3	1.0L	D194455
D194456	16.4	51	33	1.5	1.32	.27	.30	3.3	1.1	1.0L	D194456
D194457	10.8	53	31	1.9	1.38	.28	.50	1.6	1.3	1.0L	D194457
D203116	3.8	43	21	5.2	.94	6.61	.36	6.1	.96	1.3	D203116
D203117	6.5	51	28	3.1	.75	4.19	.41	3.6	.99	1.1	D203117
D203118	9.8	58	25	2.1	.55	1.95	.77	2.4	1.1	1.4	D203118
D203119	11.2	60	26	1.4	.61	1.81	.96	3.3	1.1	.45	D203119
D203113	3.7	36	25	6.6	1.10	6.75	.12	5.1	1.2	2.9	D203113
D203114	10.7	49	30	2.5	.75	2.17	.64	5.9	1.2	.65	D203114
D203115	12.9	49	34	1.4	.56	2.02	.37	2.9	1.1	.080L	D203115
D203120	13.1	49	30	2.8	1.10	.85	.47	8.2	1.1	.080	D203120
D203109	6.7	47	25	3.9	.76	2.66	.36	8.0	1.0	1.8	D203109
D203110	6.5	51	36	1.8	.35	2.38	.24	1.9	1.3	.46	D203110
D203111	10.8	64	28	.84	.25	1.84	.79	.84	1.2	.090L	D203111
D203112	9.9	54	36	1.3	.30	2.03	.30	1.9	1.3	.20	D203112
D203106	6.7	49	34	2.9	.31	2.70	.24	2.6	1.2	.90	D203106
D203107	8.5	51	36	1.1	.25	2.38	.24	1.8	1.4	.11L	D203107
D203108	10.8	54	34	1.0	.28	1.93	.39	1.1	1.2	.090L	D203108
D203100	16.6	64	21	2.4	1.34	.53	2.2	4.4	.92	.060	D203100
D203102	18.5	64	21	2.8	1.34	.68	1.8	4.3	.88	.32	D203102
D203103	43.3	71	17	2.2	1.25	1.26	1.9	2.1	.68	.070	D203103
D203105	19.7	62	25	2.0	1.21	.55	1.6	3.2	.93	.050L	D203105
D203095	11.1	54	34	1.2	.33	1.90	.37	1.4	1.1	.090L	D203095
D203096	10.5	45	32	4.8	1.31	2.10	.24	1.6	1.1	.59	D203096
D203098	14.3	54	26	3.8	1.00	1.15	.84	2.6	.91	.070	D203098
D203099	8.9	36	19	6.7	1.49	.62	.060	22	.73	.11	D203099
D203091	19.1	51	26	2.8	.85	2.60	.54	5.0	.87	.050L	D203091
D203092	12.5	45	26	8.3	.86	2.38	.43	4.0	.89	.48	D203092
D203093	18.5	51	32	3.4	.75	1.65	.84	3.1	.84	.050L	D203093
D203094	12.8	60	14	4.6	1.00	2.35	.46	8.2	.65	.23	D203094
D203089	12.4	49	26	5.6	1.10	3.78	.37	2.9	.77	.080L	D203089
D203090	12.2	49	23	5.6	1.18	2.66	.90	5.6	.90	.080L	D203090
D180095	20.1	36	23	13	2.70	.58	.23	2.5	.72	1.0L	D180095
D180096	34.7	51	28	2.9	1.19	.49	.87	4.1	.78	1.0L	D180096
D184655	7.2	48	31	3.4	.83	.91	.29	4.6	1.6	1.0L	D184655
D184656	20.2	29	20	27	3.55	.64	.17	3.4	.73	1.0L	D184656

Table G3. (cont.)

Major- and minor-oxide and trace element composition of the laboratory ash of 45 coal samples from the Mesaverde Formation, Grand Mesa coal field, Delta and Mesa Counties, Colorado--continued

Sample number	SO3 (percent)	B-S (ppm)	Ba-S (ppm)	Be-S (ppm)	Cd (ppm)	Cu (ppm)	Ga-S (ppm)	Ge-S (ppm)	La-S (ppm)	Li (ppm)	Sample number
D191607	1.1	700	2,000	10	1.0L	63	70	N	70	121	D191607
D194452	1.7	1,500	3,000	3	1.0L	80	70	N	150	89	D194452
D194453	1.7	1,500	3,000	3	1.0L	65	50	N	100	112	D194453
D194454	1.1	1,500	2,000	5	1.0L	83	70	N	100	127	D194454
D194455	1.4	1,500	5,000	5	1.0L	75	70	N	70	144	D194455
D194456	1.1	1,000	2,000	5	1.0L	53	70	N	100	195	D194456
D194457	.90	1,500	1,500	5	1.0L	90	70	N	70	119	D194457
D203116	8.0	5,000	10,000	3	1.0	114	50	N	100L	59	D203116
D203117	2.2	2,000	7,000	15	1.0L	66	70	N	100L	100	D203117
D203118	1.7	1,500	5,000	7	1.0	76	70	N	100L	133	D203118
D203119	1.3	1,000	3,000	3	1.0	82	50	N	100L	101	D203119
D203113	7.3	3,000	10,000	15	2.0	100	70	70	100L	125	D203113
D203114	1.7	1,500	3,000	3	1.0	76	70	N	100	125	D203114
D203115	.50	1,000	3,000	3	1.0L	61	70	N	100	147	D203115
D203120	1.8	1,000	5,000	7	1.0	66	50	N	100L	110	D203120
D203109	2.5	1,500	2,000	3	1.0	88	30	N	100L	94	D203109
D203110	.50	2,000	2,000	3	2.0	87	70	N	150	139	D203110
D203111	.50	1,000	1,500	7	1.0	73	50	N	100L	129	D203111
D203112	.54	1,000	2,000	7	1.0	87	50	N	100L	186	D203112
D203106	.75	1,500	1,500	10	1.0	83	70	N	100	137	D203106
D203107	.50	1,500	1,000	15	1.0L	104	50	20L	100L	194	D203107
D203108	.30	1,000	1,000	10	1.0	84	70	20	100L	168	D203108
D203100	1.9	700	1,500	10	1.0L	66	30	N	500*	53	D203100
D203102	1.9	700	1,000	3	1.0L	60	30	N	N	63	D203102
D203103	1.3	150	1,500	N	1.0L	35	30	N	100L	46	D203103
D203105	1.5	500	1,000	3	1.0L	68	30	N	100L	88	D203105
D203095	.75	700	5,000	7	1.0L	80	70	20L	100L	152	D203095
D203096	2.4	1,000	5,000	3	1.0	76	50	N	100L	294	D203096
D203098	2.5	700	3,000	10	1.0L	86	70	N	100L	86	D203098
D203099	7.0	1,500	1,000	15	1.0L	50	50	30	100L	85	D203099
D203091	2.5	700	2,000	7	1.0	61	50	N	100L	93	D203091
D203092	4.3	1,000	7,000	7	1.0	73	70	N	100L	135	D203092
D203093	1.4	700	2,000	7	1.0L	46	50	N	100L	90	D203093
D203094	7.5	1,000	2,000	7	1.0L	43	30	N	N	100	D203094
D203089	3.8	1,500	2,000	5	1.0L	51	50	N	100L	79	D203089
D203090	5.3	1,000	1,500	7	1.0L	83	50	N	100L	108	D203090
D180095	3.2	300	1,000	5	1.0L	37	30	N	100L	137	D180095
D180096	2.3	150	700	5	1.0L	37	30	N	100	156	D180096
D184655	2.4	1,000	1,000	15	1.0L	116	30	20	100L	180	D184655
D184656	4.4	300	1,000	3	1.0L	33	20	N	100L	120	D184656

Table G3. (cont.)

Major- and minor-oxide and trace element composition of the laboratory ash of 45 coal samples from the Mesaverde Formation, Grand Mesa coal field, Delta and Mesa Counties, Colorado--continued

Sample number	Mn (ppm)	Mo-S (ppm)	Nb-S (ppm)	Ni-S (ppm)	Pb (ppm)	Sc-S (ppm)	Sr-S (ppm)	V-S (ppm)	Y-S (ppm)	Yb-S (ppm)	Sample number
D191607	40	N	20	15	65	10	300	70	30	3	D191607
D194452	440	7	30	15	55	20	700	100	70	5	D194452
D194453	480	7	30	15	60	15	700	70	50	5	D194453
D194454	210	7	30	15	65	20	700	100	50	5	D194454
D194455	160	7	20	20	55	20	700	150	70	5	D194455
D194456	70	7L	30	10L	70	20	500	70	70	5	D194456
D194457	185	10	30	30	50	20	500	150	50	5	D194457
D203116	140	30	N	50	44	15	3,000	150	50	5	D203116
D203117	63	20	30	30	61	15	2,000	150	50	5	D203117
D203118	85	15	N	50	50	15	2,000	150	30	3	D203118
D203119	67	15	30	30	51	20	2,000	150	30	3	D203119
D203113	220	10	20	100	51	20	5,000	150	50	5	D203113
D203114	440	7	20	15	109	15	2,000	150	50	5	D203114
D203115	115	7	30	20	51	15	1,000	100	30	3	D203115
D203120	1,120	7	30	20	45	15	1,500	70	30	3	D203120
D203109	110	30	N	30	50	10	1,000	100	30	3	D203109
D203110	27	N	N	15	85	10	1,000	100	50	3	D203110
D203111	22	N	N	30	71	15	300	70	30	3	D203111
D203112	31	7	30	30	67	15	700	150	50	5	D203112
D203106	45	7	20	20	90	15	700	70	50	3	D203106
D203107	36	7	30	30	71	15	500	150	30	3	D203107
D203108	36	7	30	30	282	15	300	100	50	3	D203108
D203100	155	7	20	30	47	15	300	150	30	3	D203100
D203102	215	N	N	15	49	10	200	70	30	3	D203102
D203103	220	N	20	15	26	10L	150	70	30	3	D203103
D203105	180	7L	20	30	49	15	200	150	30	3	D203105
D203095	67	7	30	30	82	15	500	100	30	3	D203095
D203096	140	7	20	20	101	15	2,000	70	30	3	D203096
D203098	105	7	30	20	55	15	1,000	150	50	5	D203098
D203099	470	N	20	20	29	20	1,000	70	70	7	D203099
D203091	105	10	20	30	51	15	700	100	50	5	D203091
D203092	295	15	20	30	48	15	2,000	100	50	5	D203092
D203093	155	7	30	15	45	15	700	70	70	7	D203093
D203094	420	7	20	15	33	15	1,000	70	30	3	D203094
D203089	190	10	20	20	58	15	1,000	70	50	5	D203089
D203090	220	10	20	30	73	15	1,000	100	50	5	D203090
D180095	95	7	30	10L	50	10	500	70	70	7	D180095
D180096	50	7	30	15	75	10	300	100	50	5	D180096
D184655	120	7	70	20	70	20	150	150	100	10	D184655
D184656	80	7	30	10L	35	15	700	50	70	7	D184656

Table G3. (cont.)

Major- and minor-oxide and trace element composition of the laboratory ash of 45 coal samples from the Mesaverde Formation, Grand Mesa coal field, Delta and Mesa Counties, Colorado--continued

Sample number	Zn (ppm)	Zr-S (ppm)
D191607	80	300
D194452	89	200
D194453	58	200
D194454	79	300
D194455	66	300
D194456	55	300
D194457	92	300
D203116	72	200
D203117	54	200
D203118	55	200
D203119	75	300
D203113	59	300
D203114	254	300
D203115	75	300
D203120	88	300
D203109	81	150
D203110	73	300
D203111	73	300
D203112	76	300
D203106	125	300
D203107	93	300
D203108	182	300
D203100	163	300
D203102	102	300
D203103	91	200
D203105	116	200
D203095	102	300
D203096	66	300
D203098	63	300
D203099	230	300
D203091	137	300
D203092	111	300
D203093	72	300
D203094	175	300
D203089	108	300
D203090	179	300
D180095	46	200
D180096	115	200
D184655	98	500
D184656	59	200

Table G3. (cont.)

Major- and minor-oxide and trace element composition of the laboratory ash of 45 coal samples from the Mesaverde Formation, Grand Mesa coal field, Delta and Mesa Counties, Colorado--continued

Sample number	Ash (percent)	SiO2 (percent)	Al2O3 (percent)	CaO (percent)	MgO (percent)	Na2O (percent)	K2O (percent)	Fe2O3 (percent)	TiO2 (percent)	P2O5 (percent)	Sample number
D203087	13.7	21	12	35	1.25	0.68	0.020L	5.4	0.62	1.0	D203087
D203088	20.2	43	26	8.4	1.52	.30	.41	6.9	.85	.050L	D203088
D203083	15.0	56	25	5.7	1.39	.70	.37	3.2	.80	.13	D203083
D203084	15.2	56	34	1.2	.15	.45	.32	3.1	1.0	.72	D203084
D203086	7.9	43	21	1.4	.25	.93	.24	23	.89	.38	D203086

Sample number	SO3 (percent)	B-S (ppm)	Ba-S (ppm)	Be-S (ppm)	Cd (ppm)	Cu (ppm)	Ga-S (ppm)	Ge-S (ppm)	La-S (ppm)	Li (ppm)	Sample number
D203087	7.0	1,000	3,000	3	1.0L	46	30	N	N	42	D203087
D203088	2.2	500	1,000	3	1.0L	46	50	N	N	108	D203088
D203083	1.6	300	700	3	1.0L	65	30	N	100L	105	D203083
D203084	.20	300	700	5	1.0L	56	50	N	100L	195	D203084
D203086	.80	700	300	7	1.0L	66	50	30	100L	133	D203086

Sample number	Mn (ppm)	Mo-S (ppm)	Nb-S (ppm)	Ni-S (ppm)	Pb (ppm)	Sc-S (ppm)	Sr-S (ppm)	V-S (ppm)	Y-S (ppm)	Yb-S (ppm)	Sample number
D203087	310	7	N	10	40	10	2,000	70	30	3	D203087
D203088	1,830	7L	N	10L	56	15	300	70	30	3	D203088
D203083	71	10	30	15	57	10	500	70	30	3	D203083
D203084	31	7	30	20	70	15	700	70	50	3	D203084
D203086	175	15	30	30	65	15	700	70	70	5	D203086

Sample number	Zn (ppm)	Zr-S (ppm)
D203087	68	150
D203088	58	300
D203083	117	200
D203084	54	300
D203086	95	200

Table G4.

Contents of nine trace elements in 45 coal samples from the Mesaverde Formation, Grand Mesa coal field, Delta and Mesa Counties, Colorado

[Analyses in air-dried (32°C) coal. L, less than the value shown]

Sample number	As (ppm)	Co (ppm)	Cr (ppm)	F (ppm)	Hg (ppm)	Sb (ppm)	Se (ppm)	Th (ppm)	U (ppm)	Sample number
D191607	0.1L	1.7	3.5	100	0.06	0.8	1.7	7.5	3.0	D191607
D194452	.9	1.0	3.1	60	.06	.3	1.4	3.3	2.2	D194452
D194453	2.1	1.4	2.5	55	.12	.3	1.4	4.1	2.1	D194453
D194454	.7	1.4	1.9	80	.02	.2	.9	2.2	1.2	D194454
D194455	1.3	1.2	2.7	55	.06	.5	1.1	2.7	1.7	D194455
D194456	1.2	1.1	2.4	25	.14	.2	1.3	5.4	2.1	D194456
D194457	.6	2.1	3.0	45	.04	.2	1.9	2.2	1.1	D194457
D203116	.8	.6	1.3	30	.01	.2	.4	.6	.6	D203116
D203117	.2	.9	.1L	60	.01	.5	.6	1.7	.7	D203117
D203118	.3	1.6	4.2	60	.02	.5	1.1	1.8	1.4	D203118
D203119	.3	1.3	4.2	60	.04	.3	1.1	1.7	.9	D203119
D203113	.3	1.8	1.4	30	.01	.6	.6	.7	.3	D203113
D203114	.4	1.3	2.9	60	.02	.3	1.0	2.4	.9	D203114
D203115	.2	1.6	2.8	50	.01	.1	1.1	2.9	.9	D203115
D203120	.5	1.4	.1L	65	.01L	.3	1.2	2.9	1.0	D203120
D203109	.6	1.0	1.8	120	.02	.3	.5	1.2	1.0	D203109
D203110	.2	1.0	1.8	35	.01	.2	.8	1.9	.6	D203110
D203111	.5	2.1	3.3	35	.04	1.3	1.1	1.8	.6	D203111
D203112	.4	1.5	3.0	40	.02	.8	1.3	2.9	1.2	D203112
D203106	.2	.9	1.7	70	.02	.5	.8	2.2	.8	D203106
D203107	.1L	1.4	2.0	30	.02	.8	1.0	1.6	.8	D203107
D203108	.4	1.7	3.0	45	.03	1.2	1.3	2.8	1.3	D203108
D203100	.8	2.0	.1L	135	.03	1.3	.7	2.8	2.3	D203100
D203102	1.3	2.3	8.9	155	.02	.5	1.0	3.2	1.2	D203102
D203103	3.3	3.7	13	190	.04	.8	1.0	6.3	2.7	D203103
D203105	3.8	2.6	7.6	100	.04	.7	1.2	3.9	2.1	D203105
D203095	.8	1.5	3.8	25	.03	1.1	1.5	3.5	1.6	D203095
D203096	.5	1.3	2.8	50	.02	.3	1.4	2.9	1.3	D203096
D203098	1.7	1.7	5.6	50	.06	1.1	2.0	5.6	3.1	D203098
D203099	.9	1.3	3.1	20	.07	.1	1.0	1.4	.5	D203099
D203091	5.9	2.6	7.2	100	.14	.9	.1L	4.8	2.3	D203091
D203092	1.9	1.7	4.1	40	.05	.7	1.3	3.2	1.7	D203092
D203093	3.6	1.8	5.2	65	.05	.5	1.3	6.8	2.8	D203093
D203094	1.4	.9	4.7	20L	.11	.1	1.1	1.3	.9	D203094
D203089	.9	1.5	2.8	50	.03	.4	.9	3.2	1.5	D203089
D203090	2.9	1.6	5.2	40	.07	1.0	1.6	2.2	1.7	D203090
D180095	.5	2.0L	4.0	40	.06	.4	1.6	6.4	2.3	D180095
D180096	7.0	3.7L	11	150	.27	.6	3.1	7.2	5.4	D180096
D184655	.4	.9	.1L	40	.01	.9	1.1	2.6	1.0	D184655
D184656	.4	.8	2.8	70	.01	.1L	1.2	4.9	1.8	D184656
D203087	0.3	1.0	3.0	130	0.02	0.3	1.0	1.6	1.0	D203087
D203088	2.7	1.2	4.0	50	.04	.5	1.5	5.0	1.9	D203088
D203083	2.4	1.7	3.9	85	.07	.7	1.4	3.7	1.9	D203083
D203084	5.0	1.5	4.5	105	.10	.4	1.8	4.8	2.1	D203084
D203086	4.4	1.0	3.7	35	.20	.3	1.8	1.8	.8	D203086

Table G5.

Major-, minor-, and trace-element composition of 45 coal samples from the Mesaverde Formation, Grand Mesa coal field, Delta and Mesa Counties, Colorado

[Values in percent or parts per million. As, Co, Cr, F, Hg, Sb, Se, Th, and U values are from direct determinations on air-dried (32°C) coal; all other values calculated from analyses of coal ash. S means analysis by emission spectrography; L, less than the value shown; N, not detected; B, not determined.]

Sample number	Si (percent)	Al (percent)	Ca (percent)	Mg (percent)	Na (percent)	K (percent)	Fe (percent)	Ti (percent)	As (ppm)	B-S (ppm)	Sample number
D191607	5.1	3.6	0.31	0.075	0.13	0.15	0.083	0.13	0.1L	150	D191607
D194452	2.9	1.9	.20	.21	.027	.041	.49	.088	.9	200	D194452
D194453	3.1	2.2	.18	.25	.071	.057	.67	.081	2.1	200	D194453
D194454	2.4	1.8	.13	.11	.026	.024	.10	.076	.7	150	D194454
D194455	2.3	1.7	.10	.13	.033	.032	.22	.076	1.3	150	D194455
D194456	3.9	2.9	.18	.13	.033	.041	.38	.11	1.2	150	D194456
D194457	2.7	1.8	.15	.090	.022	.045	.12	.084	.6	150	D194457
D203116	.76	.42	.14	.022	.19	.011	.16	.022	.8	200	D203116
D203117	1.5	.96	.14	.029	.20	.022	.16	.039	.2	150	D203117
D203118	2.7	1.3	.15	.032	.14	.063	.16	.065	.3	150	D203118
D203119	3.1	1.5	.11	.041	.15	.090	.26	.074	.3	100	D203119
D203113	.62	.49	.17	.025	.19	.004	.13	.027	.3	100	D203113
D203114	2.4	1.7	.19	.048	.17	.057	.44	.077	.4	150	D203114
D203115	3.0	2.3	.13	.043	.19	.040	.26	.085	.2	150	D203115
D203120	3.0	2.1	.26	.087	.083	.051	.75	.086	.5	150	D203120
D203109	1.5	.89	.19	.031	.13	.020	.37	.040	.6	100	D203109
D203110	1.5	1.2	.084	.014	.11	.013	.086	.051	.2	150	D203110
D203111	3.2	1.6	.065	.016	.15	.071	.063	.078	.5	100	D203111
D203112	2.5	1.9	.092	.018	.15	.025	.13	.077	.4	100	D203112
D203106	1.5	1.2	.14	.013	.13	.013	.12	.048	.2	100	D203106
D203107	2.0	1.6	.067	.013	.15	.017	.11	.071	.1L	150	D203107
D203108	2.7	1.9	.077	.018	.15	.035	.083	.078	.4	100	D203108
D203100	5.0	1.8	.28	.13	.065	.30	.51	.091	.8	100	D203100
D203102	5.5	2.1	.37	.15	.093	.28	.56	.098	1.3	150	D203102
D203103	14	3.9	.68	.33	.40	.69	.64	.18	3.3	70	D203103
D203105	5.7	2.6	.28	.14	.080	.26	.44	.11	3.8	100	D203105
D203095	2.8	2.0	.095	.022	.16	.034	.11	.073	.8	70	D203095
D203096	2.2	1.8	.36	.083	.16	.021	.12	.069	.5	100	D203096
D203098	3.6	2.0	.39	.086	.12	.10	.26	.078	1.7	100	D203098
D203099	1.5	.89	.43	.080	.041	.004	1.4	.039	.9	150	D203099
D203091	4.5	2.6	.38	.098	.37	.086	.67	.10	5.9	150	D203091
D203092	2.6	1.7	.74	.065	.22	.045	.35	.067	1.9	150	D203092
D203093	4.4	3.1	.45	.084	.23	.13	.40	.093	3.6	150	D203093
D203094	3.6	.95	.42	.077	.22	.049	.73	.050	1.4	150	D203094
D203089	2.8	1.7	.50	.082	.35	.038	.25	.057	.9	200	D203089
D203090	2.8	1.5	.49	.087	.24	.091	.48	.066	2.9	150	D203090
D180095	3.4	2.5	1.9	.33	.086	.039	.35	.087	.5	70	D180095
D180096	8.2	5.1	.71	.25	.13	.25	1.0	.16	7.0	50	D180096
D184655	1.6	1.2	.17	.036	.049	.017	.23	.069	.4	70	D184655
D184656	2.7	2.1	3.9	.43	.096	.029	.48	.088	.4	70	D184656

Table G5. (cont.)

Major-, minor-, and trace-element composition of 45 coal samples from the Mesaverde Formation, Grand Mesa coal field, Delta and Mesa Counties, Colorado--continued

Sample number	Ba-S (ppm)	Be-S (ppm)	Cd (ppm)	Co (ppm)	Cr (ppm)	Cu (ppm)	F (ppm)	Ga-S (ppm)	Ge-S (ppm)	Hg (ppm)	Sample number
D191607	500	2	0.20L	1.7	3.5	12	100	15	N	0.06	D191607
D194452	300	.3	.12L	1.0	3.1	9.8	60	10	N	.06	D194452
D194453	500	.5	.14L	1.4	2.5	8.8	55	7	N	.12	D194453
D194454	200	.5	.10L	1.4	1.9	8.1	80	7	N	.02	D194454
D194455	500	.5	.10L	1.2	2.7	7.3	55	7	N	.06	D194455
D194456	300	.7	.16L	1.1	2.4	8.7	25	10	N	.14	D194456
D194457	150	.5	.11L	2.1	3.0	9.7	45	7	N	.04	D194457
D203116	300	.1	.04	.6	1.3	4.3	30	2	N	.01	D203116
D203117	500	1	.07L	.9	.1L	4.3	60	5	N	.01	D203117
D203118	500	.7	.10	1.6	4.2	7.4	60	7	N	.02	D203118
D203119	300	.3	.11	1.3	4.2	9.2	60	5	N	.04	D203119
D203113	300	.5	.07	1.8	1.4	3.7	30	2	2	.01	D203113
D203114	300	.3	.11	1.3	2.9	8.1	60	7	N	.02	D203114
D203115	500	.5	.13L	1.6	2.8	7.9	50	10	N	.01	D203115
D203120	700	1	.13	1.4	.1L	8.6	65	7	N	.01L	D203120
D203109	150	.2	.07	1.0	1.8	5.9	120	2	N	.02	D203109
D203110	150	.2	.13	1.0	1.8	5.7	35	5	N	.01	D203110
D203111	150	.7	.11	2.1	3.3	7.9	35	5	N	.04	D203111
D203112	200	.7	.10	1.5	3.0	8.6	40	5	N	.02	D203112
D203106	100	.7	.07	.9	1.7	5.6	70	5	N	.02	D203106
D203107	100	1.5	.09L	1.4	2.0	8.8	30	5	1.5L	.02	D203107
D203108	100	1	.11	1.7	3.0	9.1	45	7	2	.03	D203108
D203100	200	1.5	.17L	2.0	.1L	11	135	5	N	.03	D203100
D203102	200	.5	.19L	2.3	8.9	11	155	5	N	.02	D203102
D203103	700	N	.43L	3.7	13	15	190	15	N	.04	D203103
D203105	200	.7	.20L	2.6	7.6	13	100	7	N	.04	D203105
D203095	500	.7	.11L	1.5	3.8	8.9	25	7	2L	.03	D203095
D203096	500	.3	.11	1.3	2.8	8.0	50	5	N	.02	D203096
D203098	500	1.5	.14L	1.7	5.6	12	50	10	N	.06	D203098
D203099	100	1.5	.09L	1.3	3.1	4.5	20	5	3	.07	D203099
D203091	300	1.5	.19	2.6	7.2	12	100	10	N	.14	D203091
D203092	1,000	1	.13	1.7	4.1	9.1	40	10	N	.05	D203092
D203093	300	1.5	.19L	1.8	5.2	8.5	65	10	N	.05	D203093
D203094	200	1	.13L	.9	4.7	5.5	20L	5	N	.11	D203094
D203089	200	.7	.12L	1.5	2.8	6.3	50	7	N	.03	D203089
D203090	200	1	.12L	1.6	5.2	10	40	7	N	.07	D203090
D180095	200	1	.20L	2.0L	4.0	7.4	40	7	N	.06	D180095
D180096	200	1.5	.35L	3.7L	11	13	150	10	N	.27	D180096
D184655	70	1	.07L	.9	.1L	8.4	40	2	1.5	.01	D184655
D184656	200	.7	.20L	.8	2.8	6.7	70	5	N	.01	D184656

Table G5 (cont.)

Major-, minor-, and trace-element composition of 45 coal samples from the Mesaverde Formation, Grand Mesa coal field, Delta and Mesa Counties, Colorado--continued

Sample number	La-S (ppm)	Li (ppm)	Mn (ppm)	Mo-S (ppm)	Nb-S (ppm)	Ni-S (ppm)	P (ppm)	Pb (ppm)	Sb (ppm)	Sc-S (ppm)	Sample number
D191607	15	24	7.9	N	5	3	870L	13	0.8	2	D191607
D194452	20	11	54	1	3	2	530L	6.7	.3	2	D194452
D194453	15	15	65	1	5	2	590L	8.2	.3	2	D194453
D194454	10	12	21	.7	3	1.5	430L	6.4	.2	2	D194454
D194455	7	14	16	.7	2	2	420L	5.3	.5	2	D194455
D194456	15	32	11	1L	5	1.5L	720L	11	.2	3	D194456
D194457	7	13	20	1	3	3	470L	5.4	.2	2	D194457
D203116	3L	2.2	5.3	1	N	2	220	1.7	.2	.7	D203116
D203117	7L	6.5	4.1	1.5	2	2	310	4.0	.5	1	D203117
D203118	10L	13	8.3	1.5	N	5	600	4.9	.5	1.5	D203118
D203119	10L	11	7.5	1.5	3	3	220	5.7	.3	2	D203119
D203113	3L	4.6	8.1	.3	.7	3	470	1.9	.6	.7	D203113
D203114	10	13	47	.7	2	1.5	300	12	.3	1.5	D203114
D203115	15	19	15	1	5	2	45L	6.6	.1	2	D203115
D203120	15L	14	150	1	5	3	46	5.9	.3	2	D203120
D203109	7L	6.3	7.4	2	N	2	530	3.4	.3	.7	D203109
D203110	10	9.0	1.8	N	N	1	130	5.5	.2	.7	D203110
D203111	10L	14	2.4	N	N	3	42L	7.7	1.3	1.5	D203111
D203112	10L	18	3.1	.7	3	3	87	6.6	.8	1.5	D203112
D203106	7	9.2	3.0	.5	1.5	1.5	260	6.0	.5	1	D203106
D203107	10L	16	3.1	.7	2	2	41L	6.0	.8	1.5	D203107
D203108	10L	18	3.9	.7	3	3	42L	30	1.2	1.5	D203108
D203100	100*	8.8	26	1	3	5	44	7.8	1.3	2	D203100
D203102	N	12	40	N	N	3	260	9.1	.5	2	D203102
D203103	50L	20	95	N	10	7	130	11	.8	5L	D203103
D203105	20L	17	35	1.5L	5	7	43L	9.7	.7	3	D203105
D203095	10L	17	7.4	.7	3	3	44L	9.1	1.1	1.5	D203095
D203096	10L	31	15	.7	2	2	270	11	.3	1.5	D203096
D203098	15L	12	15	1	5	3	44	7.9	1.1	2	D203098
D203099	10L	7.6	42	N	2	2	43	2.6	.1	2	D203099
D203091	20L	18	20	2	3	7	42L	9.7	.9	3	D203091
D203092	15L	17	37	2	2	3	260	6.0	.7	2	D203092
D203093	20L	17	29	1.5	5	3	40L	8.3	.5	3	D203093
D203094	N	13	54	1	2	2	130	4.2	.1	2	D203094
D203089	15L	9.8	24	1.5	2	2	43L	7.2	.4	2	D203089
D203090	15L	13	27	1.5	2	3	43L	8.9	1.0	2	D203090
D180095	20L	28	19	1.5	7	2L	880L	10	.4	2	D180095
D180096	30	54	17	2	10	5	1,500L	26	.6	3	D180096
D184655	7L	13	8.6	.5	5	1.5	310L	5.0	.9	1.5	D184655
D184656	20L	24	16	1.5	7	2L	880L	7.1	.1L	3	D184656

Table G5 (cont.)

Major-, minor-, and trace-element composition of 45 coal samples from the Mesaverde Formation, Grand Mesa coal field, Delta and Mesa Counties, Colorado--continued

Sample number	Se (ppm)	Sr-S (ppm)	Th (ppm)	U (ppm)	V-S (ppm)	Y-S (ppm)	Yb-S (ppm)	Zn (ppm)	Zr-S (ppm)	Sample number
D191607	1.7	70	7.5	3.0	15	7	0.7	16	70	D191607
D194452	1.4	100	3.3	2.2	15	10	.7	11	20	D194452
D194453	1.4	100	4.1	2.1	10	7	.7	7.9	30	D194453
D194454	.9	70	2.2	1.2	10	5	.5	7.7	30	D194454
D194455	1.1	70	2.7	1.7	15	7	.5	6.4	30	D194455
D194456	1.3	70	5.4	2.1	10	10	.7	9.0	50	D194456
D194457	1.9	50	2.2	1.1	15	5	.5	9.9	30	D194457
D203116	.4	100	.6	.6	7	2	.2	2.7	7	D203116
D203117	.6	150	1.7	.7	10	3	.3	3.5	15	D203117
D203118	1.1	200	1.8	1.4	15	3	.3	5.4	20	D203118
D203119	1.1	200	1.7	.9	15	3	.3	8.4	30	D203119
D203113	.6	200	.7	.3	5	2	.2	2.2	10	D203113
D203114	1.0	200	2.4	.9	15	5	.5	27	30	D203114
D203115	1.1	150	2.9	.9	15	5	.5	9.7	50	D203115
D203120	1.2	200	2.9	1.0	10	5	.5	12	50	D203120
D203109	.5	70	1.2	1.0	7	2	.2	5.4	10	D203109
D203110	.8	70	1.9	.6	7	3	.2	4.7	20	D203110
D203111	1.1	30	1.8	.6	7	3	.3	7.9	30	D203111
D203112	1.3	70	2.9	1.2	15	5	.5	7.5	30	D203112
D203106	.8	50	2.2	.8	5	3	.2	8.4	20	D203106
D203107	1.0	50	1.6	.8	15	2	.2	7.9	20	D203107
D203108	1.3	30	2.8	1.3	10	5	.3	20	30	D203108
D203100	.7	50	2.8	2.3	20	5	.5	27	50	D203100
D203102	1.0	30	3.2	1.2	15	5	.5	19	50	D203102
D203103	1.0	70	6.3	2.7	30	15	1.5	39	100	D203103
D203105	1.2	50	3.9	2.1	30	7	.7	23	50	D203105
D203095	1.5	50	3.5	1.6	10	3	.3	11	30	D203095
D203096	1.4	200	2.9	1.3	7	3	.3	6.9	30	D203096
D203098	2.0	150	5.6	3.1	20	7	.7	9.0	50	D203098
D203099	1.0	100	1.4	.5	7	7	.7	20	30	D203099
D203091	.1L	150	4.8	2.3	20	10	1	26	70	D203091
D203092	1.3	200	3.2	1.7	15	7	.7	14	30	D203092
D203093	1.3	150	6.8	2.8	15	15	1.5	13	50	D203093
D203094	1.1	150	1.3	.9	10	5	.5	22	50	D203094
D203089	.9	150	3.2	1.5	10	7	.7	13	30	D203089
D203090	1.6	150	2.2	1.7	15	7	.7	22	30	D203090
D180095	1.6	100	6.4	2.3	15	15	1.5	9.2	50	D180095
D180096	3.1	100	7.2	5.4	30	15	1.5	40	70	D180096
D184655	1.1	10	2.6	1.0	10	7	.7	7.1	30	D184655
D184656	1.2	150	4.9	1.8	10	15	1.5	12	50	D184656

Table G5 (cont.)

Major-, minor-, and trace-element composition of 45 coal samples from the Mesaverde Formation, Grand Mesa coal field, Delta and Mesa Counties, Colorado--continued

Sample number	Si (percent)	Al (percent)	Ca (percent)	Mg (percent)	Na (percent)	K (percent)	Fe (percent)	Ti (percent)	As (ppm)	B-S (ppm)	Sample number
D203087	1.3	0.87	3.4	0.10	0.069	0.002L	0.52	0.051	0.3	150	D203087
D203088	4.1	2.8	1.2	.18	.045	.069	.97	.10	2.7	100	D203088
D203083	3.9	2.0	.61	.13	.078	.046	.34	.072	2.4	50	D203083
D203084	4.0	2.7	.13	.014	.051	.041	.33	.091	5.0	50	D203084
D203086	1.6	.88	.079	.012	.054	.016	1.3	.042	4.4	50	D203086

Sample number	Ba-S (ppm)	Be-S (ppm)	Cd (ppm)	Co (ppm)	Cr (ppm)	Cu (ppm)	F (ppm)	Ga-S (ppm)	Ge-S (ppm)	Hg (ppm)	Sample number
D203087	500	0.5	0.14L	1.0	3.0	6.3	130	5	N	0.02	D203087
D203088	200	.7	.20L	1.2	4.0	9.3	50	10	N	.04	D203088
D203083	100	.5	.15L	1.7	3.9	9.8	85	5	N	.07	D203083
D203084	100	.7	.15L	1.5	4.5	8.5	105	7	N	.10	D203084
D203086	20	.5	.08L	1.0	3.7	5.2	35	5	2	.20	D203086

Sample number	La-S (ppm)	Li (ppm)	Mn (ppm)	Mo-S (ppm)	Nb-S (ppm)	Ni-S (ppm)	P (ppm)	Pb (ppm)	Sb (ppm)	Sc-S (ppm)	Sample number
D203087	N	5.8	42	1	N	1.5	600	5.5	0.3	1.5	D203087
D203088	N	22	370	1.5L	N	2L	44L	11	.5	3	D203088
D203083	15L	16	11	1.5	5	2	85	8.6	.7	1.5	D203083
D203084	15L	30	4.7	1	5	3	480	11	.4	2	D203084
D203086	7L	11	14	1	2	2	130	5.1	.3	1	D203086

Sample number	Se (ppm)	Sr-S (ppm)	Th (ppm)	U (ppm)	V-S (ppm)	Y-S (ppm)	Yb-S (ppm)	Zn (ppm)	Zr-S (ppm)	Sample number
D203087	1.0	300	1.6	1.0	10	5	0.5	9.3	20	D203087
D203088	1.5	70	5.0	1.9	15	7	.7	12	70	D203088
D203083	1.4	70	3.7	1.9	10	5	.5	18	30	D203083
D203084	1.8	100	4.8	2.1	10	7	.5	8.2	50	D203084
D203086	1.8	50	1.8	.8	5	5	.5	7.5	15	D203086

Table G6.

Elements looked for, but not detected in 45 coal samples from the Mesaverde Formation, Grand Mesa coal field, Delta and Mesa Counties, Colorado

[Approximate lower detection limits for these elements in ash, by the six-step spectrographic method of the U.S. Geological Survey, are included]

Element name	Symbol	Lower limit of detection (ppm) in ash
Silver	Ag	1
Gold	Au	50
Bismuth	Bi	20
Dysprosium	Dy	100
Erbium	Er	100
Europium	Eu	200
Gadolinium	Gd	100
Hafnium	Hf	200
Holmium	Ho	50
Indium	In	20
Lutetium	Lu	70
Palladium	Pd	5
Praseodymium	Pr	200
Platinum	Pt	100
Rhenium	Re	100
Samarium	Sm	200
Tin	Sn	20
Tantalum	Ta	1,000
Terbium	Tb	700
Tellurium	Te	5,000
Thallium	Tl	100
Thulium	Tm	50
Tungsten	W	200

Table G7.

Arithmetic mean, observed range, geometric mean, and geometric deviation of proximate and ultimate analyses, heat of combustion, forms of sulfur, and ash-fushion temperatures of 43 coal samples from the Mesaverde Formation, Grand Mesa coal field, Delta and Mesa Counties, Colorado

[For comparison, geometric means for 86 Rocky Mountain Province coal samples are included (Swanson and others, 1976, Table 33a). All values are in percent except Kcal/kg, Btu/lb, ash-fusion temperatures, and geometric deviations, and are reported on the as-received basis. L, less than the value shown. G, greater than the value shown. Leaders (---) indicate no data. Kcal/kg = 0.556(Btu/lb). $^{o}F = (^{o}C \times 1.8) + 32$]

	Arithmetic mean	Observed range		Geometric mean	Geometric deviation	Rocky Mountain Province geometric mean
		Minimum	Maximum			
Proximate and ultimate analyses						
Moisture	13.3	2.5	20.2	11.9	1.6	10.5
Volatile matter	33.3	22.9	38.7	33.3	1.1	35.7
Fixed carbon	42.1	24.6	51.5	41.7	1.1	41.5
Ash	11.6	3.2	41.4	10.4	1.6	7.7
Hydrogen	5.7	4.1	6.2	5.6	1.1	5.6
Carbon	58.2	35.7	74.2	57.8	1.1	58.9
Nitrogen	1.3	.8	1.8	1.3	1.2	1.1
Oxygen	22.6	8.7	28.9	21.8	1.3	22.4
Sulfur	.7	.4	2.2	.7	1.5	.5
Heat of combustion						
Kcal/kg	5,700	3,450	7,500	5,660	1.1	6,180
Btu/lb	10,260	6,200	13,490	10,180	1.1	11,110
Forms of sulfur						
Sulfate	0.01	0.01L	0.06	0.01	1.5	0.02
Pyritic	.12	.02	1.55	.08	2.7	.11
Organic	.57	.34	1.26	.54	1.4	.22
Ash-fusion temperatures, ^{o}C						
Initial deformation	1,360	1,125	1,600G	1,350	1.1	---
Softening temperature	1,390	1,180	1,600G	1,390	1.1	---
Fluid temperature	1,435	1,230	1,600G	1,430	1.1	---

Table G8.

Arithmetic mean, observed range, geometric mean, and geometric deviation of ash content and contents of 10 major and minor oxides in the laboratory ash of 45 coal samples from the Mesaverde Formation, Grand Mesa coal field, Delta and Mesa Counties, Colorado

[For comparison, geometric means for 295 Rocky Mountain Province coal samples are included (Hatch and Swanson, 1977, Table 3a). All samples were ashed at 525°C; all analyses except geometric deviation are in percent. L, less than the value shown. Leaders (---) indicate no data.

Oxide	Arithmetic mean	Observed range		Geometric mean	Geometric deviation	Rocky Mountain Province geometric mean
		Minimum	Maximum			
(Ash)	13.5	3.7	43.3	12.1	1.6	10.9
SiO_2	50	21	71	49	1.2	44
Al_2O_3	28	12	36	27	1.3	19
CaO	4.2	.84	35	3.0	2.2	6.2
MgO	1.2	.15	3.6	.87	2.1	1.4
Na_2O	1.7	.27	6.8	1.2	2.3	.68
K_2O	.58	.06L	2.2	.42	2.2	.45
Fe_2O_3	4.5	.60	23	3.5	2.1	4.5
TiO_2	1.0	.62	1.6	1.0	1.2	.81
SO_3	2.5	.20	8.0	1.7	2.4	5.1
P_2O_5	.58	.06L	2.9	.07	8.4	---

Table G9.

Arithmetic mean, observed range, geometric mean, and geometric deviation of 39 elements in 45 coal samples from the Mesaverde Formation, Grand Mesa coal field, Delta and Mesa Counties, Colorado

[For comparison, geometric means for 295 Rocky Mountain Province coal samples are included (Hatch and Swanson, 1977, Table 3b). All analyses except geometric deviation are in percent or parts per million and are reported on a whole coal basis. As, Co, Cr, F, Hg, Sb, Se, Th, and U values used to calculate the statistics were determined directly on whole coal. All other values used were calculated from determinations made on coal ash. L, less than the value shown. Leaders (---) indicate no data.]

Element	Arithmetic mean	Observed range		Geometric mean	Geometric deviation	Rocky Mountain Province geometric mean
		Minimum	Maximum			
			Percent			
Si	3.3	0.62	14	2.7	1.8	2.3
Al	1.9	.42	5.1	1.7	1.6	1.1
Ca	.41	.065	3.9	.26	2.7	.48
Mg	.10	.012	.43	.063	2.7	.089
Na	.14	.022	.40	.11	2.1	.055
K	.079	.004L	.69	.042	3.1	.041
Fe	.40	.063	1.4	.29	2.2	.34
Ti	.078	.022	.18	.072	1.5	.047
P	.017	.004L	.059	.005	5.1	---
			Parts per million			
As	1.5	0.2L	7	0.8	3.0	2
B	150	50	200	100	1.5	70
Ba	300	20	1000	200	2.1	150
Be	.7	.1L	2	.7	2.0	.5
Cd	.05	.03L	.19	.02	3.3	.05
Co	1.4	.6	3.7	1.3	1.4	1.5
Cr	3.8	1.3	13	3.2	1.8	5
Cu	8.5	3.7	15	8	1.4	8.4
F	65	20L	190	56	1.8	69
Ga	7	2	15	7	1.6	3
Ge	1	1.5L	3	.7	1.9	---
Hg	.05	.01L	.27	.03	2.4	.05
La	7	7L	30	5	2.4	---
Li	16	2.2	54	14	1.7	8
Mn	30	1.8	370	16	3.1	20
Mo	1	.3L	2	.7	2.2	1.5
Nb	3	.7L	10	2	2.5	.5
Ni	3	1L	7	2	1.7	2
Pb	8.1	1.7	30	7	1.7	4.7
Sb	.6	.09L	1.3	.4	2.1	.3
Sc	2	.7L	3	1.5	1.5	1.5
Se	1.2	.4L	3.1	1.1	1.5	1.2
Sr	100	10	300	100	2.0	100
Th	3.3	.6	7.5	2.8	1.8	2.9
U	1.6	.3	5.4	1.3	1.8	1.1
V	15	5	30	10	1.6	100
Y	7	2	15	5	1.8	5
Yb	.7	.2	1.5	.5	1.8	.5
Zn	13	2.2	40	11	1.9	6.8
Zr	30	7	100	30	1.7	20

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