

THE GEOLOGICAL SURVEY OF WYOMING

Gary B. Glass, State Geologist



**ANALYSES AND MEASURED SECTIONS
OF SEVEN COAL SAMPLES FROM
THE ROCK SPRINGS DISTRICT,
GREEN RIVER BASIN COAL FIELD,
SOUTHWESTERN WYOMING**

by

Gary B. Glass and Jay T. Roberts



**Report of Investigations No. 41
1988**

Laramie, Wyoming

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Cover: Western Wyoming Fuel Company's small Swanson underground mine is currently the only mine extracting coal from the Rock Springs Formation. In the past, however, Union Pacific Coal Company and others had extensive underground mines in the Rock Springs area. The most recent larger underground mine, the Stansbury mine, closed in 1980. (Drawing by Phyllis A. Ranz.)

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Introduction

In August of 1975, Geological Survey of Wyoming personnel collected seven face-channel coal samples from mines and outcrops located in the Rock Springs coal district in southwestern Wyoming (Figure 1). Representative splits of these samples were sent to the U.S. Bureau of Mines in Pittsburgh, Pennsylvania, and the U.S. Geological Survey in Denver, Colorado, for analysis. Proximate and ultimate analyses, ash composition, and trace element concentrations were determined by these laboratories. To compliment the analyses, detailed measured sections and megascopic descriptions of the coal beds and asso-

ciated rocks were made at each sampling site (see Appendices).

It is stressed at the onset that there are not enough analyses in this report to characterize any individual coals or mines. The chemical and physical characterization of Wyoming's coals by either individual coal bed or coals in specific mines, coal fields, or geologic formations is deferred until other published and unpublished analyses are integrated with these. Such characterization is part of an ongoing study at the Geological Survey of Wyoming.

Sample procedures

For the most part, the sampled coal beds represent important mineable beds in the Rock Springs district. Four samples were collected from abandoned strip mines; two samples were collected from active underground mines; and one sample was collected from a recently excavated roadcut. All samples were selected on the basis of freshness of exposure and ease of sampling the entire height of the bed.

Locations of sample sites within the Rock Springs district are shown on Figure 1. A detailed location map of each sample site is provided in the Appendices.

The seven samples represent five of the major mineable coal beds in the Rock Springs Formation of the district. Figure 1 shows the approximate stratigraphic positions of the sampled coal beds. Because of inadequate geologic control, the identification of the coal beds at sample sites 75-10 (Rock Springs No. 3) and 75-12 (Rock Springs No. 1) are tentative.

Field sampling technique

All the analyses in this report are of face-channel samples. In this sampling method, a hand pick is used to cut a vertical channel (approximately 6 inches wide by 2 inches deep) from the top to the bottom of an exposed coal face (Glass, 1975). Individual samples then represent the entire thickness of each sampled coal, excluding all unmined portions of the bed. Usually these unmined portions are noncoaly partings of shale or other rock. Conversely, all noncoaly partings that are mined along with the coal are left in the samples. This deviates from older procedures that required a sampler to pick out and discard all partings of shale, pyrite, or other noncoaly material greater than 3/8-inch thick -- in essence cleaning the coal. This older conventional practice was avoided because Wyoming's coals are not cleaned after mining. Since the analyses of "as-used" coals are as important to the prediction of plant emissions as they are to the prediction of its combustion behavior in those

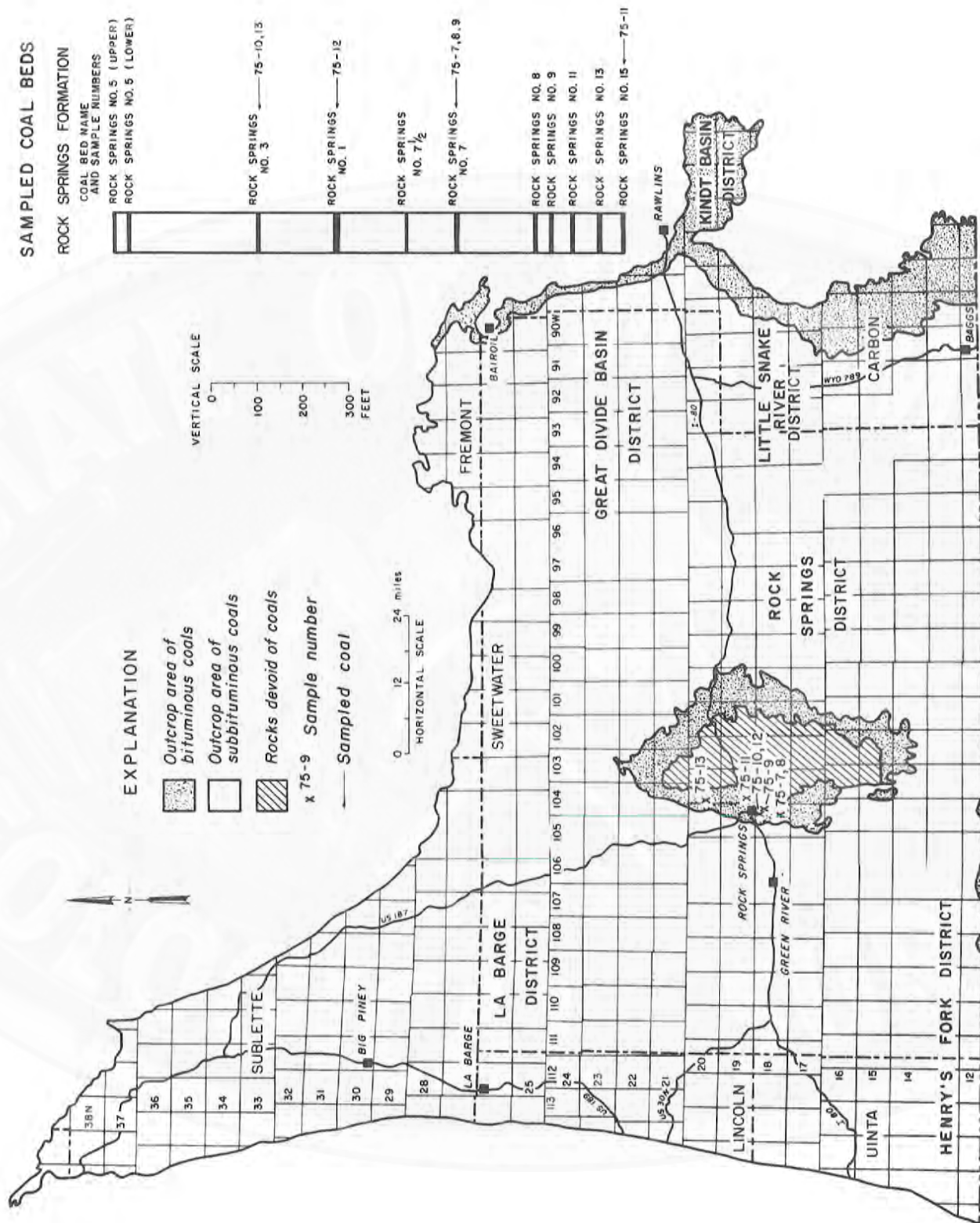


Figure 1. Map showing location of seven coal samples from the Rock Springs Formation in the Green River Basin coal field.

plants, the removal of mined impurities could lessen the value of the analyses for both these purposes.

Handling and preparation of samples

As the coal was cut from a channel, it was placed in plastic bags. These bags were sealed, placed in airtight steel cans and shipped back to Laramie.

Coal analyses and physical tests

Proximate and ultimate analyses as well as determinations of heat values, forms of sulfur, and fusibility temperatures of ash are reported for all samples. Free-swelling indices and Hardgrove grindability indices are also provided for all samples. Concentrations of major, minor, and trace elements are reported for each sample as well.

These analyses and tests were performed by either the U.S. Bureau of Mines' Coal Analysis Section in Pittsburgh, Pennsylvania, or the U.S. Geological Survey's Branch of Analytical Laboratories in Denver, Colorado. Table 1 shows the analyses or tests performed by each of the laboratories.

Routine coal analyses and physical tests

The U.S. Bureau of Mines' Coal Analysis Section did the routine proximate and ultimate analyses as well as the determinations of heat values and the forms of sulfur. The results of these analyses and mean values are given in Table 2 on an as-received, dry, and ash-free basis. The fusibility temperatures of ash, Hardgrove grindability indices, and free-swelling indices of the samples are also provided. The results of these tests are shown in Table 3 along with mean values for everything but free-swelling indices.

The analytical methods used by the U.S. Bureau of Mines are described in

At the Survey's laboratory in Laramie, the coal samples were crushed to one inch or smaller fragments (1-inch x 0) using a commercial jaw crusher. Two representative splits of about one to three pounds each were obtained by repeatedly passing the crushed coal through a riffle-type sample splitter. One split was later shipped to the U.S. Bureau of Mines and the other to the U.S. Geological Survey for analysis.

Section 5, Volume 05.05, of the *Annual book of ASTM standards* (American Society of Testing and Materials, 1983) and in U.S. Bureau of Mines Bulletin 638 (Office of Coal Research, 1967).

Major and minor elements in coal ash

The U.S. Geological Survey determined concentrations of 11 major and minor elements in each sample. These elements were silicon, aluminum, calcium, magnesium, sodium, potassium, iron, manganese, titanium, phosphorus, and sulfur. Analysis for all these elements was done on 525°C laboratory ash. The U.S. Geological Survey's sequence of sample preparation and chemical analysis is shown in Figure 2.

Tables 4 and 5 give the results of these analyses as percent oxides in the ash and as percent elements calculated back to whole coal, respectively. The tables also list the mean values of the oxides of the ash and elements on a whole-coal basis.

Trace elements in coal

The U.S. Geological Survey determined concentrations of 31 different trace elements in these coal samples. Twenty-four of these elements were identified in 525°C laboratory ash. Elements determined in the ash were boron, barium, beryllium, cadmium, cerium, cobalt,

Table 1. Analyses and physical tests performed by the U.S. Bureau of Mines and the U.S. Geological Survey.

U.S. Bureau of Mines	U.S. Geological Survey
Proximate analysis (percent)	Major and minor elements (percent) ¹
Moisture	Silicon (Si)
Volatile matter	Aluminum (Al)
Fixed carbon	Calcium (Ca)
Ash	Magnesium (Mg)
	Sodium (Na)
Ultimate analysis (percent)	Potassium (K)
Hydrogen (H)	Iron (Fe)
Carbon (C)	Manganese (Mn)
Nitrogen (N)	Titanium (Ti)
Oxygen (O)	Phosphorous (P)
Sulfur (S)	Sulfur (S)
Ash	
Heat value (Btu/pound)	Trace elements (ppm) ²
Forms of sulfur (percent)	Antimony (Sb)
Sulfate	Arsenic (As)
Pyritic	Barium (Ba)
Organic	Beryllium (Be)
	Boron (B)
Fusibility of ash (°F)	Cadmium (Cd)
Initial deformation temperature	Cerium (Ce)
Softening temperature	Chromium (Cr)
Fluid temperature	Cobalt (Co)
	Copper (Cu)
Hardgrove grindability Index	Fluorine (F)
	Gallium (Ga)
Free-swelling Index	Germanium (Ge)
	Lanthanum (La)
	Lead (Pb)
	Lithium (Li)
	Mercury (Hg)
	Molybdenum (Mo)
	Neodymium (Nd)
	Nickel (Ni)
	Niobium (Nb)
	Scandium (Sc)
	Selenium (Se)
	Strontium (Sr)
	Thorium (Th)
	Uranium (U)
	Vanadium (V)
	Ytterbium (Yb)
	Yttrium (Y)
	Zinc (Zn)
	Zirconium (Zr)

¹ Reported as oxides and elements in 525°C laboratory ash.

² Reported as parts per million (ppm) 525°C laboratory ash and/or parts per million on a whole-coal basis.

chromium, copper, gallium, germanium, lanthanum, lithium, molybdenum, niobium, nickel, lead, scandium, strontium, vanadium, yttrium, ytterbium, zinc, and zirconium. The remaining seven elements were determined on whole or raw coal, not on the ash. These elements were arsenic, fluorine, mercury, antimony, selenium, thorium, and uranium.

The results of the trace element analyses are contained in Tables 6 and 7.

Statistical summaries for some of these data are included in each table for comparison.

Figure 3 shows the U.S. Geological Survey's sequence of sample preparation and chemical analysis for all 31 elements. Analyses of 12 of the elements were quantitative determinations. These were arsenic, cadmium, copper, fluorine, mercury, lithium, lead, selenium, anti-

Table 2. Proximate and ultimate analyses, heat values, and forms of sulfur of seven face-channel samples of coal from the Upper Cretaceous Rock Springs Formation¹.

Sample number	County, Section, Township, Range	Coal district, mine name, mine type	Coal name, bed thickness (feet), sample thickness (feet)	Proximate analysis (percent)	Ultimate analysis (percent)	Sulfur forms (percent)	Heat Value	Basis ²									
				Moisture	Volatiles matter	Fixed carbon	Ash	H	C	N	O	S	Sulfate	Pyritic	Organic	btu/pound	
75-7	Sweetwater	Rock Springs	Rock Springs No. 7	8.5	36.9	48.2	6.4	5.5	66.5	1.6	19.2	0.8	0.06	0.05	0.65	11,600	1
K-58207	26, T18N, R105W	Columbine	5.6	40.3	52.7	7.0	5.4	72.7	1.7	12.7	0.9	0.07	0.05	0.71	12,680	2	
		Inactive strip	4.7	43.4	56.6			78.1	1.9	13.7	0.9	0.07	0.06	0.76	13,630	3	
75-8	Sweetwater	Rock Springs	Rock Springs No. 7	11.1	36.6	48.6	3.7	5.7	66.6	0.6	22.6	0.8	0.13	0.07	0.55	11,620	1
K-58208	26, T18N R105W	Columbine	4.8	41.2	54.7	4.2	5.0	74.9	0.7	14.3	0.9	0.15	0.08	0.62	13,070	2	
		Inactive strip	4.8	43.0	57.0			78.2	0.7	14.9	0.9	0.15	0.08	0.65	13,640	3	
75-9	Sweetwater	Rock Springs	Rock Springs No. 7	9.5	37.6	48.9	4.0	5.6	67.3	0.5	21.8	0.8	0.13	0.05	0.66	11,740	1
K-58209	12, T18N, R105W	Colony No. 2	7.0	41.5	54.0	4.4	5.0	74.4	0.6	14.8	0.9	0.14	0.06	0.73	12,970	2	
		Abandoned strip	6.8	43.5	56.5			77.8	0.6	15.4	0.9	0.15	0.06	0.76	13,570	3	
75-10	Sweetwater	Rock Springs	Rock Springs No. 3(?)	14.4	31.4	46.5	7.7	5.2	58.1	1.0	27.3	0.7	0.08	0.01	0.57	9,720	1
K-58210	2, T18N, R105W	Unknown	6.0	36.7	54.3	9.0	4.2	67.9	1.2	16.9	0.8	0.09	0.01	0.67	11,360	2	
		Abandoned strip	6.0	40.3	59.7			74.6	1.3	18.6	0.9	0.10	0.01	0.73	12,480	3	
75-11	Sweetwater	Rock Springs	Rock Springs No. 15	11.7	36.3	48.2	3.8	5.7	66.2	1.1	22.2	1.0	0.15	0.13	0.71	11,490	1
K-58211	29, T19N, R104W	Swanson	3.7	41.1	54.5	4.3	5.0	75.0	1.2	13.4	1.1	0.17	0.15	0.80	13,010	2	
		Active deep	3.7	43.0	57.0			78.3	1.3	14.0	1.2	0.18	0.15	0.84	13,600	3	
75-12	Sweetwater	Rock Springs	Rock Springs No. 1(?)	10.2	35.3	44.2	10.3	5.3	60.8	0.8	21.7	1.1	0.10	0.38	0.67	10,640	1
K-58212	2, T18N, R105W	-	11.0	39.3	49.2	11.5	4.6	67.7	0.9	14.1	1.2	0.11	0.42	0.75	11,850	2	
		Roadcut	11.0	44.4	55.6			76.5	1.0	15.9	1.4	0.13	0.48	0.84	13,380	3	
75-13	Sweetwater	Rock Springs	Rock Springs No. 3	16.7	35.7	45.4	2.2	5.8	61.7	1.3	28.1	0.9	0.12	0.07	0.75	10,520	1
K-58213	19, T20N, R104W	Stansbury	8.0+	42.9	54.5	2.6	4.7	74.1	1.6	15.3	1.1	0.14	0.08	0.90	12,630	2	
		Active deep	6.8	44.0	56.0			76.1	1.6	16.3	1.1	0.14	0.08	0.92	12,970	3	
Mean values (7 samples)				11.7	35.7	47.1	5.4	5.5	63.9	1.0	23.3	0.9	0.11	0.11	0.65	11,050	1
					40.4	53.5	6.1	4.8	72.4	1.1	14.6	1.0	0.12	0.12	0.74	12,500	2
					43.1	56.9		5.1	77.1	1.2	15.6	1.0	0.13	0.13	0.78	13,320	3

¹ All these analyses were performed by the U.S. Bureau of Mines' Coal Analysis Section in Pittsburgh, Pennsylvania.

² The analyses are reported as: (1) sample, as-received; (2) sample, moisture-free (dry); and (3) sample, moisture- and ash-free (dry, ash-free).

Table 3. Fusibility of ashes, Hardgrove grindability indices, and free-swelling indices of seven face-channel samples of coal from the Rock Springs Formation¹.

Sample number	Laboratory number	Fusibility of ash (temperature °F)			Hardgrove grindability Index	Free-swelling Index
		Initial deformation	Softening temperature	Fluid temperature		
75- 7	K-58207	2,910+	-----	-----	48	1/2
75- 8	K-58208	2,330	2,380	2,480	53	1/2
75- 9	K-58209	2,140	2,190	2,270	54	1/2
75-10	K-58210	2,910+	-----	-----	70	noncaking
75-11	K-58211	2,300	2,350	2,410	56	1/2
75-12	K-58212	2,910+	-----	-----	55	1/2
75-13	K-58213	2,050	2,090	2,130	52	1/2
Mean values, all samples		2,200 ²	2,250 ²	2,320 ²	55	

¹ All these tests were performed by the U.S. Bureau of Mines' Coal Analysis Section in Pittsburgh, Pennsylvania.

² Only four samples were averaged because the other three samples showed no initial deformation at 2,910°F.

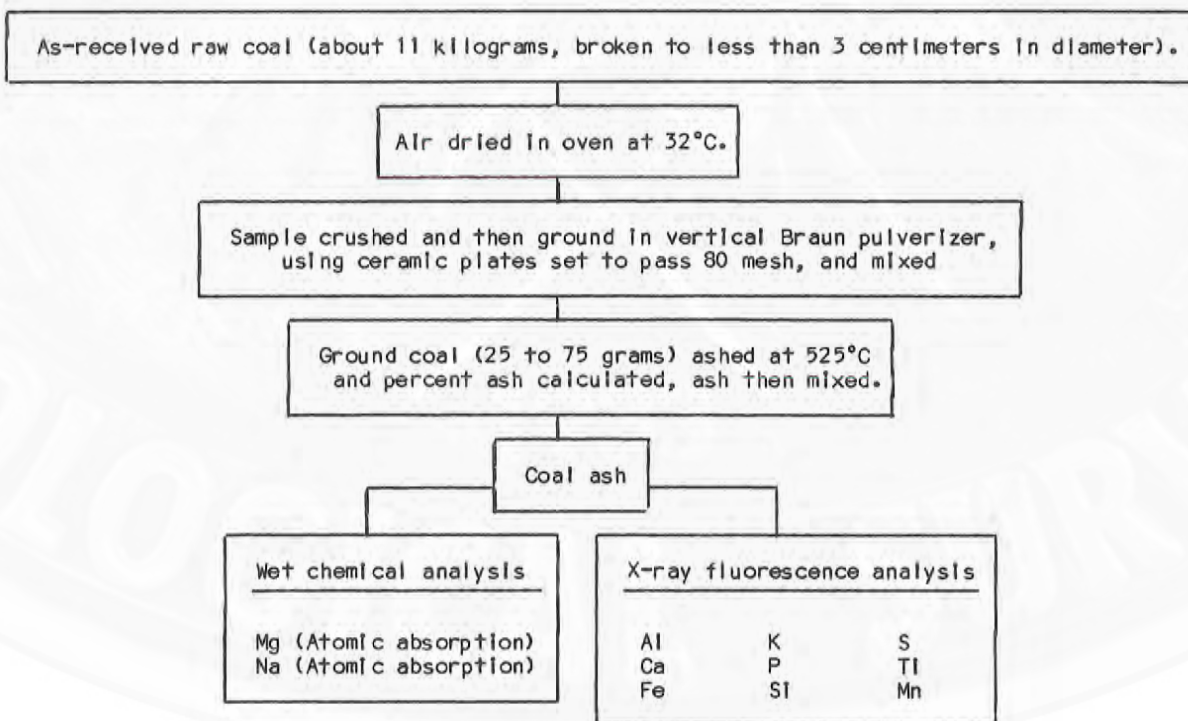


Figure 2. The U.S. Geological Survey's laboratory sequence of sample preparation and chemical analysis for major and minor elements in coal.

Table 4. Major and minor oxide composition of the 525°C laboratory ash (percent by weight).¹

Sample number	Lab number	Ash	SiO ₂	Al ₂ O ₃	CaO	MgO	Na ₂ O	K ₂ O	Fe ₂ O ₃	MnO	TiO ₂	P ₂ O ₅	SO ₃	Total
75- 7	D177427	7.4	49	32	3.3	0.66	0.16	0.72	3.3	0.014	1.1	1.7	1.5	93.454
75- 8	D177428	4.5	50	23	4.4	0.76	0.27	0.86	8.7	0.019	0.90	1.9	3.2	94.009
75- 9	D177429	5.0	52	28	1.6	0.51	0.09	0.68	5.8	0.018	0.94	1.3	1.1	92.038
75-10	D177430	10.0	68	23	0.64	0.20	<0.09	0.30	1.5	0.003	1.0	0.46	0.55	<95.743
75-11	D177431	4.1	33	21	12.0	1.38	0.32	0.55	12.0	0.048	0.73	2.1	6.8	89.928
75-12	D177432	10.5	56	26	0.40	0.50	0.16	1.3	7.8	0.021	1.1	0.19	0.72	94.191
75-13	D177433	2.7	20	10	14.0	10.0	0.50	0.46	9.8	0.046	0.50	<0.10	28.	<93.406
Mean values, seven samples		6.3	47	23	5.2	2.0	<0.23	0.70	7.0	0.024	0.90	<1.1	6.0	<93.253

¹ All these analyses were performed by the U.S. Geological Survey's Branch of Analytical Laboratories in Denver, Colorado.

Table 5. Major and minor element composition reported on a whole-coal basis (percent by weight)¹.

Sample number	Lab number	Si	Al	Ca	Mg	Na	K	Fe	Mn	Ti	P
75- 7	D177427	1.7	1.2	0.17	0.030	0.009	0.044	0.17	0.00081	0.048	0.056
75- 8	D177428	1.1	0.54	0.14	0.021	0.009	0.032	0.27	0.00068	0.024	0.037
75- 9	D177429	1.2	0.75	0.056	0.015	0.003	0.029	0.20	0.00070	0.028	0.028
75-10	D177430	3.2	1.2	0.046	0.012	<0.007	0.025	0.10	0.00020	0.062	0.020
75-11	D177431	0.63	0.46	0.35	0.034	0.010	0.019	0.33	0.0015	0.018	0.038
75-12	D177432	2.8	1.4	0.030	0.032	0.013	0.11	0.58	0.0017	0.068	0.0086
75-13	D177433	0.25	0.15	0.27	0.163	0.010	0.010	0.19	0.00097	0.008	<0.0012
Mean values, 7 samples		1.6	0.81	0.15	0.044	<0.009	0.038	0.26	0.00094	0.037	<0.027

¹ All these values were calculated from major and minor oxide composition of the 525° laboratory ash as reported in Table 4.

mony, thorium, uranium, and zinc. The other elements were determined semiquantitatively by emission spectroscopy. The results of the semiquantitative emission spectrographic analyses are 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, and so forth, but which are

reported as midpoints of the brackets. The midpoints of these brackets are 0.15, 0.2, 0.3, 0.5, 0.7, 1.0, respectively. The precision of the reported value is approximately plus-or-minus one bracket at the 68-percent confidence level, or two brackets at the 95-percent confidence level (Swanson and Huffman, 1976).

Table 6. Trace element composition of the 525°C laboratory ash of coal samples¹ (in parts per million of the ash).

Sample and lab number	Ash %	B	Ba	Be	Cd	Ce	Co	Cr	Cu	Ga	Ge	La	Li	Mo	Nb	Nd	Ni	Pb	Sc	Sr	V	Y	Yb	Zn	Zr
75-7 D177427	7.4	2,000	2,000	15	1.5	<500.	15	70	96	30	N	<100	171	15	30	<150	30	65	20	1,500	150	70	7	97	500
75-8 D177428	4.5	5,000	2,000	20	1.5	<500.	15	100	86	50	30	150	104	15	30	<150	30	55	30	1,500	200	150	7	72	500
75-9 D177429	5.0	3,000	2,000	30	2.5	N	15	70	65	30	50	100	177	15	30	N	70	50	70	1,500	150	150	7	189	700
75-10 D177430	10.0	1,500	1,500	15	1.0	N	10	30	29	30	70	<100	101	N	30	<150	50	45	20	700	100	70	7	75	700
75-11 D177431	4.1	7,000	7,000	30	1.5	<500.	15	70	81	70	70	<100	115	7	30	<150	70	35	70	2,000	150	150	7	158	700
75-12 D177432	10.5	1,500	1,000	20	<1.0	<500.	15	70	38	30	N	150	101	15	30	<150	30	60	30	300	150	100	7	114	1,000
75-13 D177433	2.7	10,000	300	7	1.0	N	15	30	60	15	N	N	112	30	<20	-	30	28	30	100	70	70	5	44	500
Mean value, all samples	6.3	2	2,000	20	<1.5	<500 ³	15	70	65	30 ³	50	<100 ³	126	15 ³	30 ³	<150 ³	50	48	2	2	150	100	7 ³	107	700

¹ All these analyses were performed by the U.S. Geological Survey's Branch of Analytical Laboratories in Denver.

² Too variable to average.

³ Most common value rather than mean.

N = not detected.

Table 7. Trace element composition of coal samples reported on a whole-coal basis¹ (in parts per million).

Sample and lab number	As	B	Ba	Be	Cd	Ce	Co	Cr	Cu	F	Ga	Ge	Hg	La	Li	Mo	Nb	Nd	Ni	Pb	Sb	Sc	Se	Sr	Tb	Ti	V	Y	Yb	Zn	Zr
75-7 D177427	1	150	150	1	0.11	<30	1.0	5.0	7.1	90	2.0	N	0.03	<7	12.7	1.0	2.0	<10	2.0	4.8	0.7	1.5	2.1	100	<3	1.6	10	5	0.5	7.2	30
75-8 D177428	2	200	100	1	0.07	<20	0.7	5.0	3.9	40	2.0	1.5	0.05	7	4.7	0.7	1.5	<7	1.5	2.5	0.5	1.5	1.4	70	<3	0.6	10	7	0.3	3.2	20
85-9 D177429	2	150	100	1.5	0.12	N	0.7	3.0	3.3	20	1.5	2.0	0.14	5	8.9	0.7	1.5	N	3.0	2.5	0.4	3.0	1.1	70	<3	0.8	7	7	0.3	9.5	30
75-10 D177430	1	150	150	1.5	0.10	N	1.0	3.0	2.9	50	3.0	7.0	0.04	<10	10.1	N	3.0	<15	5.0	4.5	0.4	2.0	0.5	70	<3	0.9	10	7	0.7	7.5	70
75-11 D177431	2	300	300	1.5	0.06	<20	0.7	3.0	3.3	50	3.0	3.0	0.13	<5	4.7	0.3	1.5	<7	3.0	1.4	0.7	3.0	1.2	70	<3	0.5	7	7	0.3	6.5	30
75-12 D177432	4	150	100	2	<0.11	<50	1.5	7.0	4.0	20	3.0	N	0.06	15	10.6	1.5	3.0	<15	3.0	6.3	0.4	3.0	1.2	30	<3	1.7	15	10	0.7	12.0	100
75-13 D177433	1	300	7	0.2	0.03	N	0.5	0.7	1.6	20	0.5	N	0.03	N	3.0	0.7	<0.5	N	0.7	0.8	0.3	0.7	0.8	3	<3	0.4	2	2	0.15	1.2	15
Mean value, 7 samples	1	200	100 ³	1.5	<0.10	<20 ³	1.0	5.0	3.7	40	3.0 ³	— ²	0.07	<7	7.8	0.7 ³	<2	<10	3.0	3.3	0.5	2.0	1.2	70 ³	<3	0.9	— ²	7 ³	0.5	6.7	— ²

- ¹ All these values were determined directly by the U.S. Geological Survey's Branch of Analytical Laboratories in Denver or were calculated from ash analyses in Table 6.
 - 2 Too variable to average.
 - 3 Most common value rather than mean.
- N = not detected

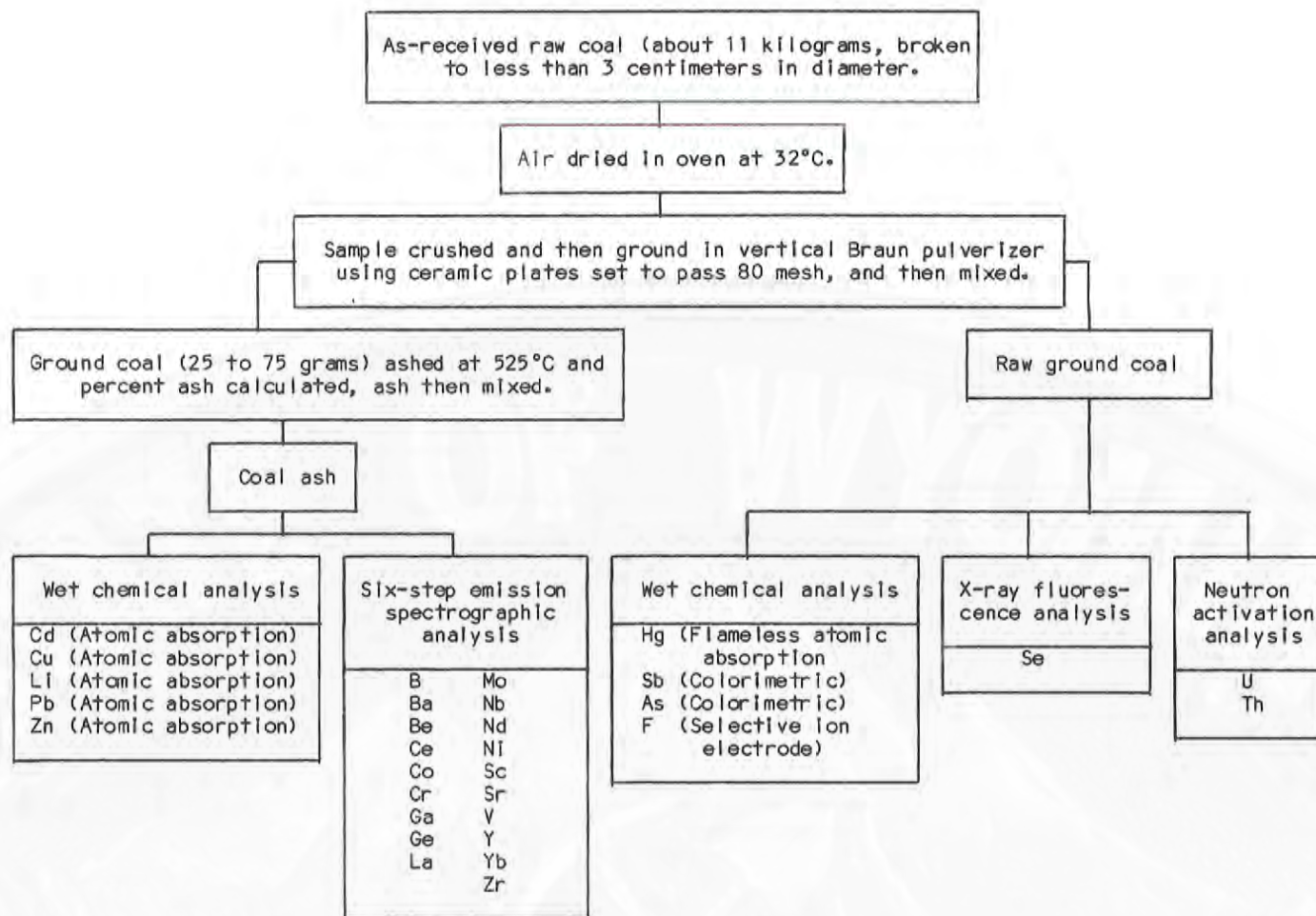


Figure 3. The U.S. Geological Survey's laboratory sequence of sample preparation and chemical analysis for trace elements in coal.

Acknowledgments

We especially acknowledge the fine analytical work provided by the Coal Analysis Section of the U.S. Bureau of Mines in Pittsburgh, Pennsylvania (the laboratory is now run by the U.S. Department of Energy), and by the U.S. Geological Survey's Branch of Analytical Laboratories in Denver, Colorado. Under a cooperative arrangement, these analyses were performed at no charge to the Geological Survey of Wyoming.

The help of Vernon E. Swanson and Joseph R. Hatch of the U.S. Geological Survey's Branch of Coal Resources is also appreciated.

Last, but certainly not least, we thank all the coal mining companies that permitted sampling in or around their mines.

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- American Society for Testing and Materials, 1983, Annual book of ASTM standards, gaseous fuels; coal and coke: Section 5, volume 05.05, Philadelphia, p. 203-489.
- Glass, G.B., 1975, Analyses and measured sections of 54 Wyoming coal samples (collected in 1974): Geological Survey of Wyoming Report of Investigations 11, 219 p.
- Office of Coal Research, 1967, Methods of analyzing and testing coal and coke: U.S. Bureau of Mines Bulletin 638, 85 p.
- Swanson, V.E., and Huffman, Claude, Jr., 1976, Guidelines for sample collecting and analytical methods used in the U.S. Geological Survey for determining chemical composition of coal: U.S. Geological Survey Circular 735, 11 p.

Appendices

Descriptions of seven coal samples collected from the Rock Springs district, Green River Basin coal field, including location maps, sample descriptions, measured sections, and megascopic descriptions of coal beds. Each measured section is described and illustrated.

Appendix A - Sample numbers 75-7 and 75-8, from the Columbine strip mine.

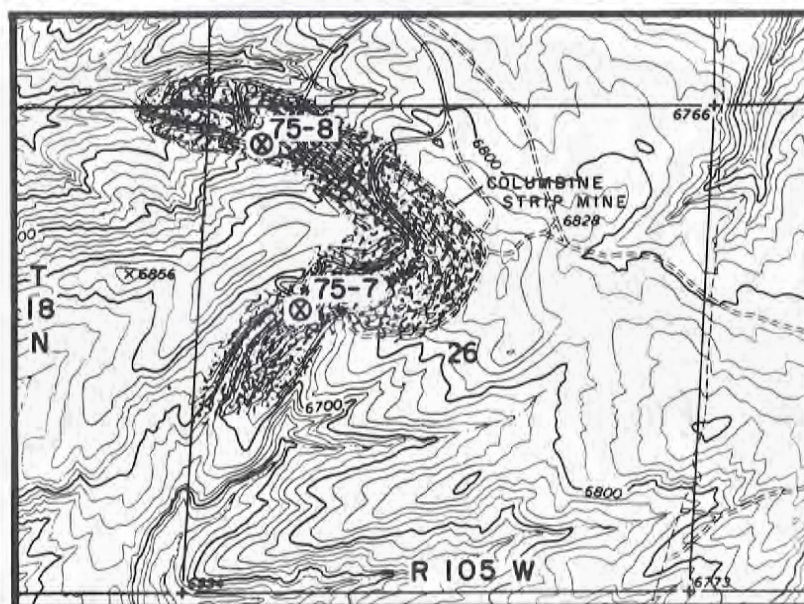
Appendix B - Sample numbers 75-9, 75-10, and 75-12, in and near the Colony strip mine.

Appendix C - Sample number 75-11, from the Swanson mine.

Appendix D - Sample number 75-13, from the Stansbury mine.

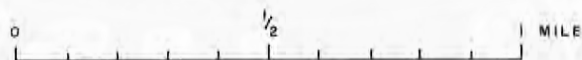
Appendix A

Appendix A. Detailed location map of sample numbers 75-7 and 75-8 in the Columbine strip mine.



EXPLANATION

-  **75-7** Sample site and sample number
-  Strip mine



Base map modified from U.S. Geological Survey's
Rock Springs (1968) 7 1/2' topographic map.

Appendix A (continued).

Sample number: 75-7

Coal name(s): Rock Spring No. 7

State: Wyoming

Geologic formation: Rock Springs

County: Sweetwater

Age: Upper Cretaceous

Section: 26

Coal district: Rock Springs

Township: 18N

Coal field: Green River Basin

Range: 105W

Total section measured (feet): 63.1

Quadrangle: Rock Springs 7 1/2-minute

Cover at sampling point (feet): 57.4'+

Elevation top of sampled coal: 6,683 feet±

Thickness of coal (feet): 5.6

Strike: 30°

Thickness sampled (feet): 4.7

Dip: 5°NW

Type of sample: face-channel

Major joint orientations in coal:

Condition of sample: weathered

70-72°, 50-56°

Type of exposure: inactive strip mine

Date of sampling: 8/12/75

Mine name: Columbine (Rainbow mine;

Sample collector: Geological Survey of Wyoming

Gunn Quealy strip no. 1)

Completion date of analyses

Laboratory numbers

U.S. Department of Energy: 2/5/76

K-58207

U.S. Geological Survey: 6/11/76

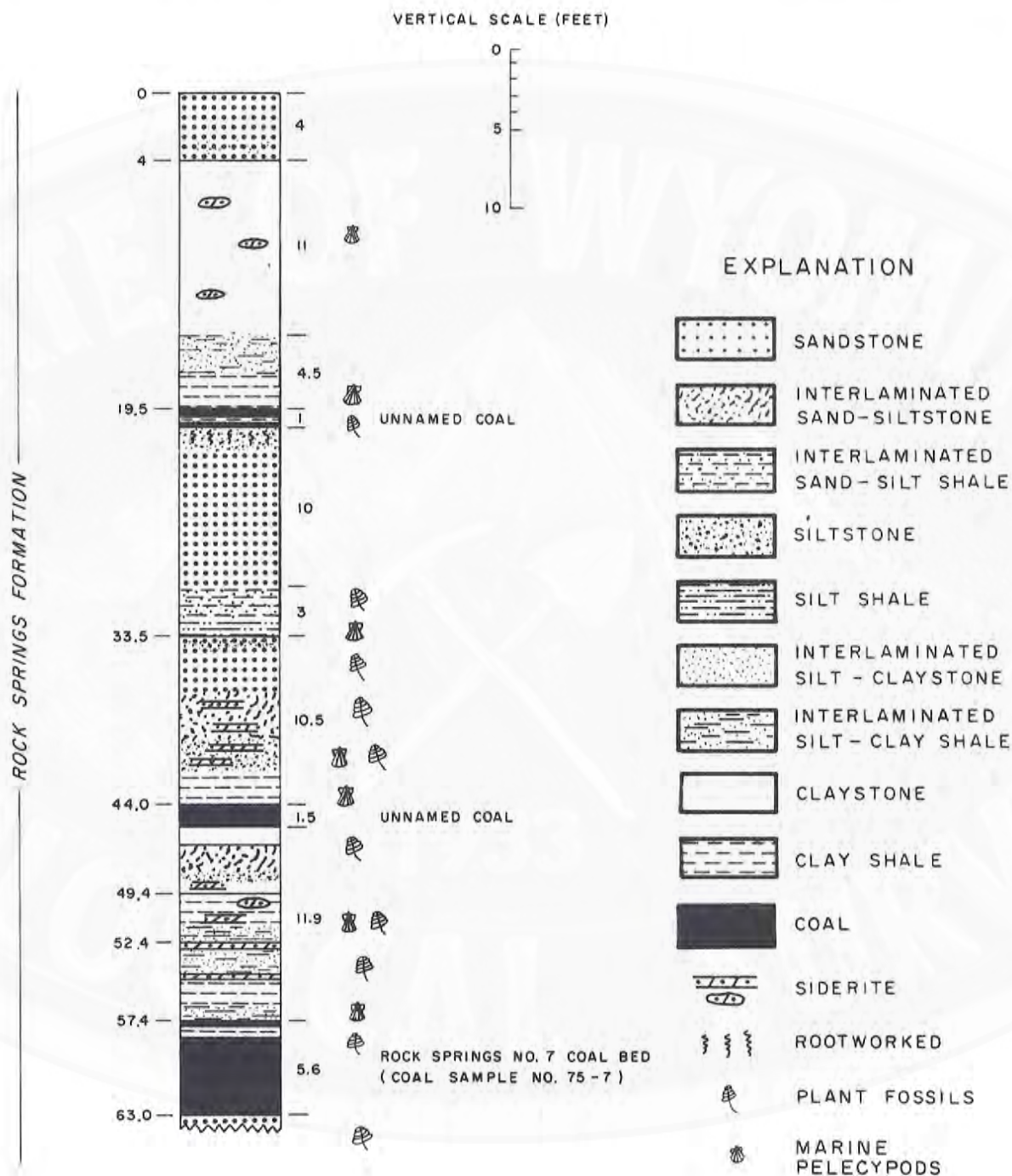
D177427

Moist, mineral-matter-free heat value: 12,480 Btu/pound

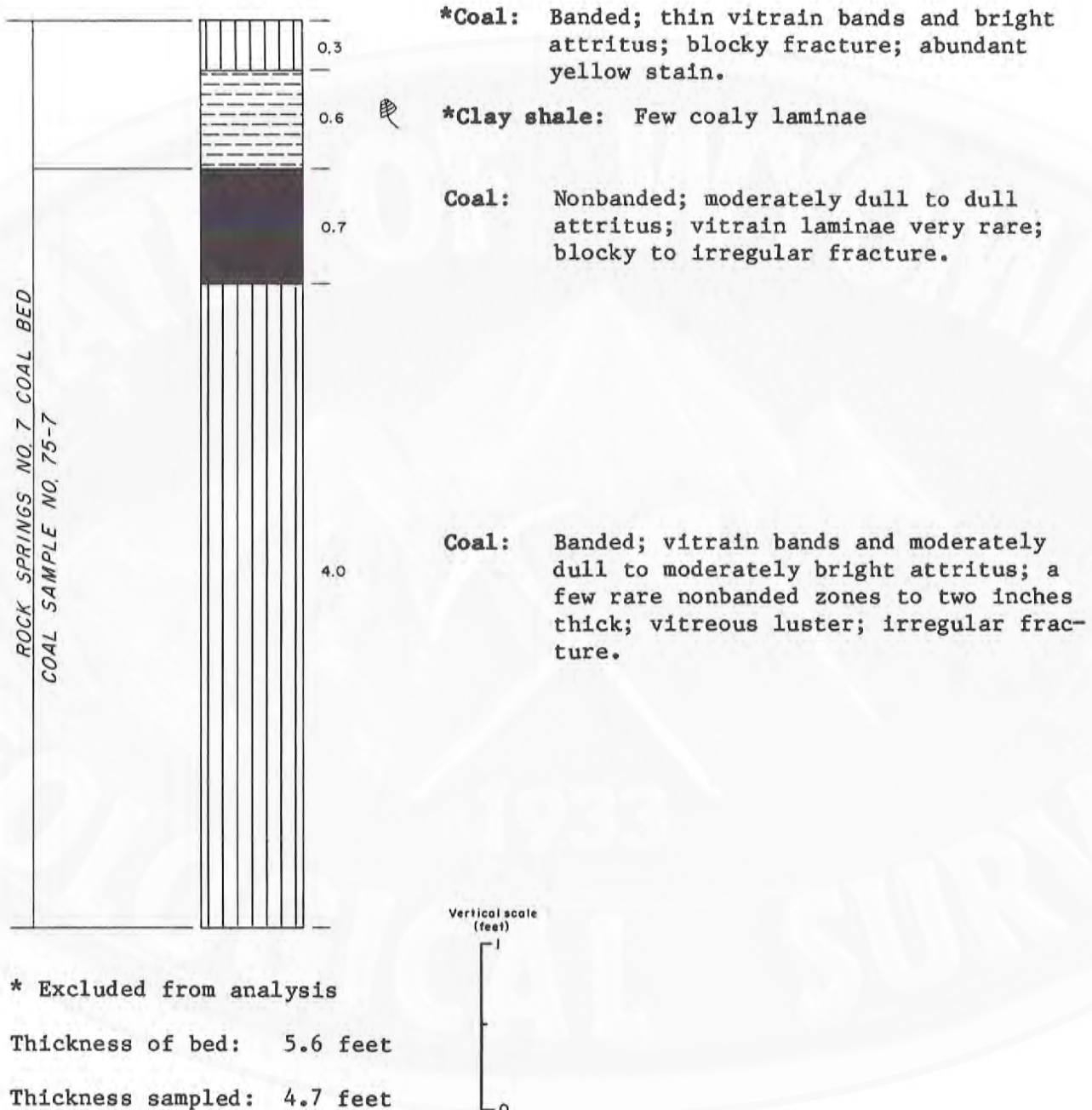
Apparent rank of coal: high volatile C bituminous

Miscellaneous comments: none

Appendix A (continued). Measured section at the Rock Springs No. 7 coal bed (southernmost sample site) in the Columbine strip mine (sample number 75-7).



Appendix A (continued). Megascopic description of the Rock Springs No. 7 coal bed (southernmost sample) in the Columbine strip mine (sample number 75-7).



Appendix A (continued).

Sample number: 75-8

Coal name(s): Rock Springs No. 7

State: Wyoming

Geologic formation: Rock Springs

County: Sweetwater

Age: Upper Cretaceous

Section: 26

Coal district: Rock Springs

Township: 18N

Coal field: Green River Basin

Range: 105W

Total section measured (feet): 52.8+

Quadrangle: Rock Springs 7 1/2-minute

Cover at sampling point (feet): 47.8

Elevation top of sampled coal: 6,632 feet±

Strike: 20°

Thickness of coal (feet): 4.8

Thickness sampled (feet): 4.8

Dip: 8°NW

Type of sample: face-channel

Major joint orientations in coal:

70-80°, 55°, 345°

Condition of sample: weathered

Type of exposure: inactive strip mine

Mine name: Columbine (Rainbow mine; Gunn
Quealy strip no. 1)

Date of sampling: 8/12/75

Sample collector: Geological Survey of Wyoming

Completion date of analyses

Laboratory numbers

U.S. Department of Energy: 2/5/76

K-58208

U.S. Geological Survey: 6/11/76

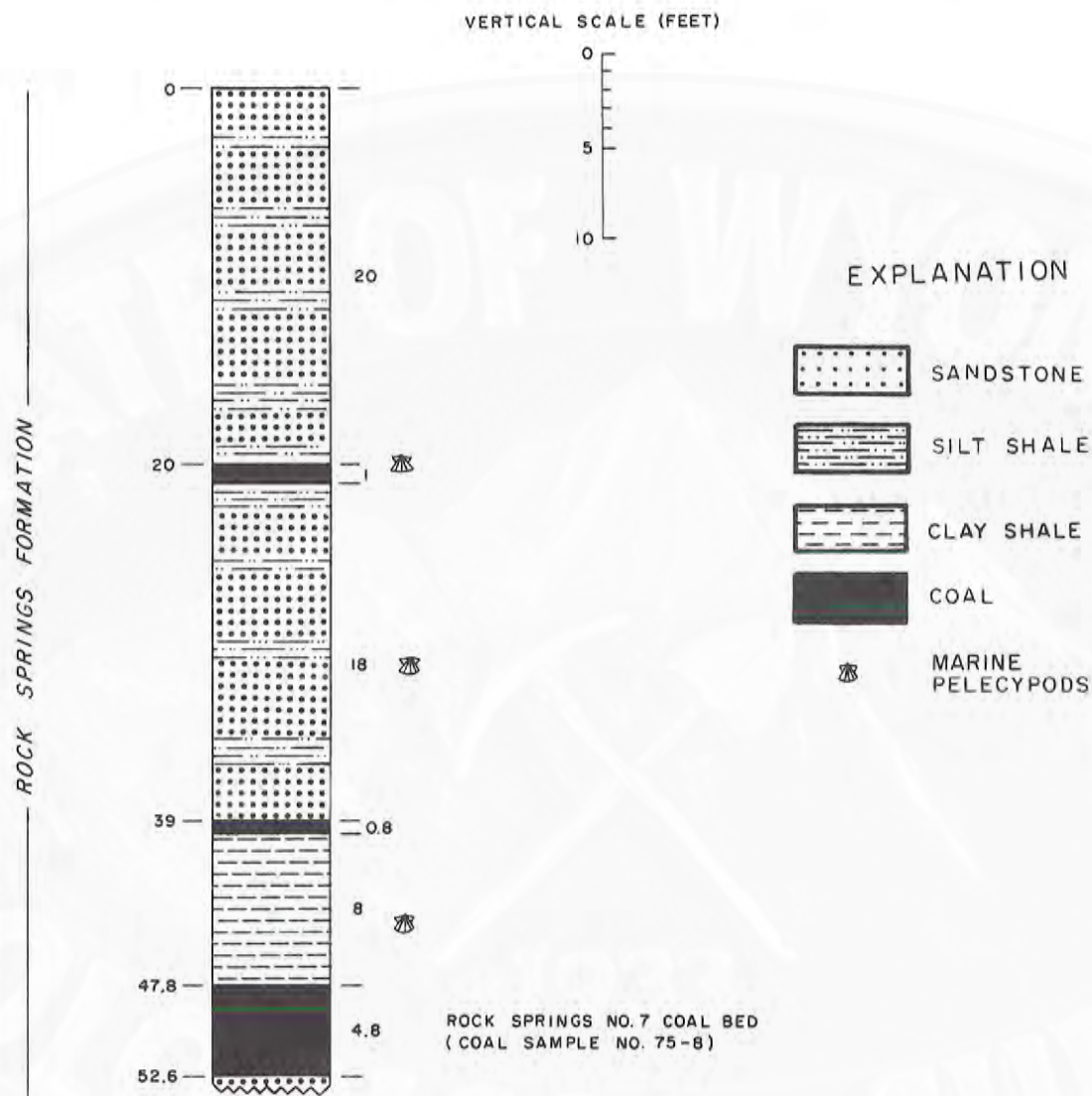
D177428

Moist, mineral-matter-free heat value: 12,120 Btu/pound

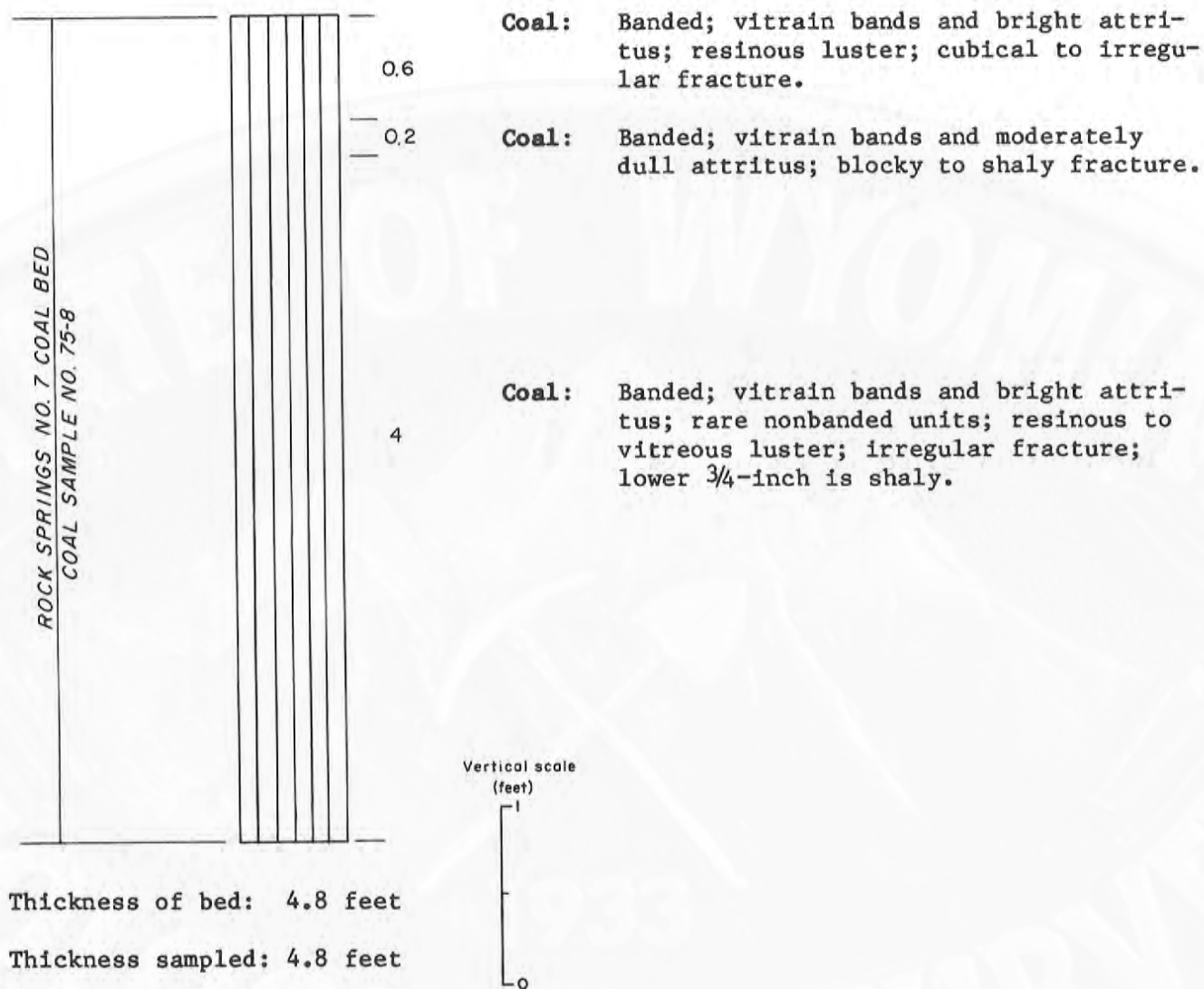
Apparent rank of coal: high volatile C bituminous

Miscellaneous comments: none.

Appendix A (continued). Measured section at the Rock Springs No. 7 coal bed (northernmost sample) in the Columbine strip mine (sample number 75-8).

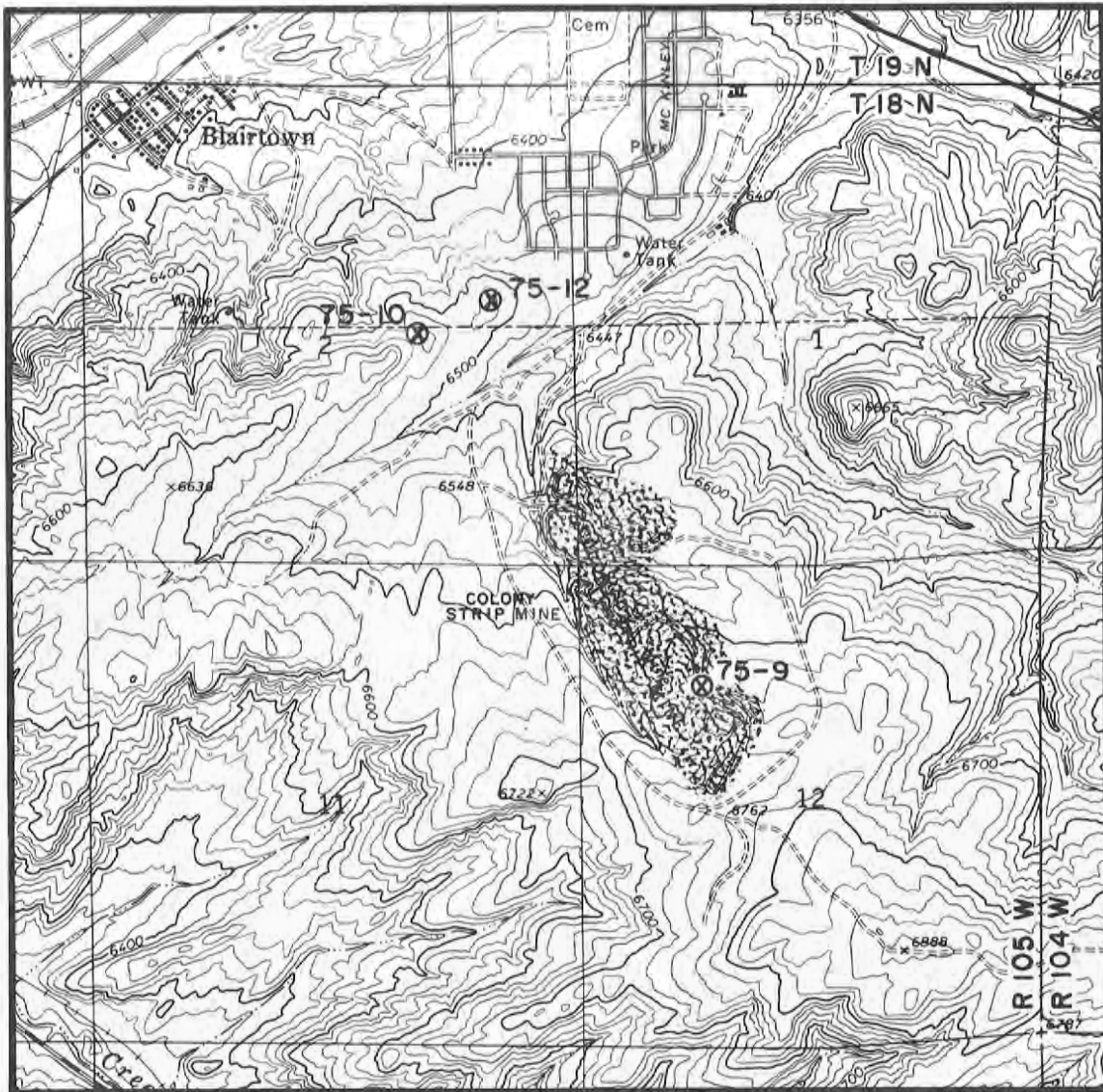


Appendix A (continued). Megascopic description of the Rock Springs No. 7 coal bed (northernmost sample) in the Columbine strip mine (sample number 75-8).



Appendix B

Appendix B. Detailed location map of sample numbers 75-9, 75-10, and 75-12 in and near the Colony strip mine.

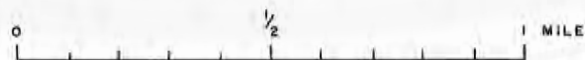


EXPLANATION

⊗ 75-10 Sample site and sample number



Strip mine



Base map modified from U.S. Geological Survey's Rock Springs (1968) 7 1/2' topographic map.

Appendix B (continued).

Sample number: 75-9

Coal name(s): Rock Springs No. 7

State: Wyoming

Geologic formation: Rock Springs

County: Sweetwater

Age: Upper Cretaceous

Section: 12

Coal district: Rock Springs

Township: 18N

Coal field: Green River Basin

Range: 105W

Total section measured (feet): 37.5'

Quadrangle: Rock Springs 7 1/2-minute

Cover at sampling point (feet): 30.7'

Elevation top of sampled coal: 6,670 feet

Strike: 75°

Thickness of coal (feet): 7.0

Dip: 4°NW

Thickness sampled (feet): 6.8

Major joint orientations in coal:
none measured

Type of sample: face-channel

Condition of sample: very weathered

Type of exposure: abandoned strip mine
Mine name: Colony strip no. 2 (Pea-
cock no. 2 strip)

Date of sampling: 8/13/75

Sample collector: Geological Survey of Wyoming

Completion date of analyses

Laboratory numbers

U.S. Department of Energy: 2/5/76

K-58209

U.S. Geological Survey: 6/11/76

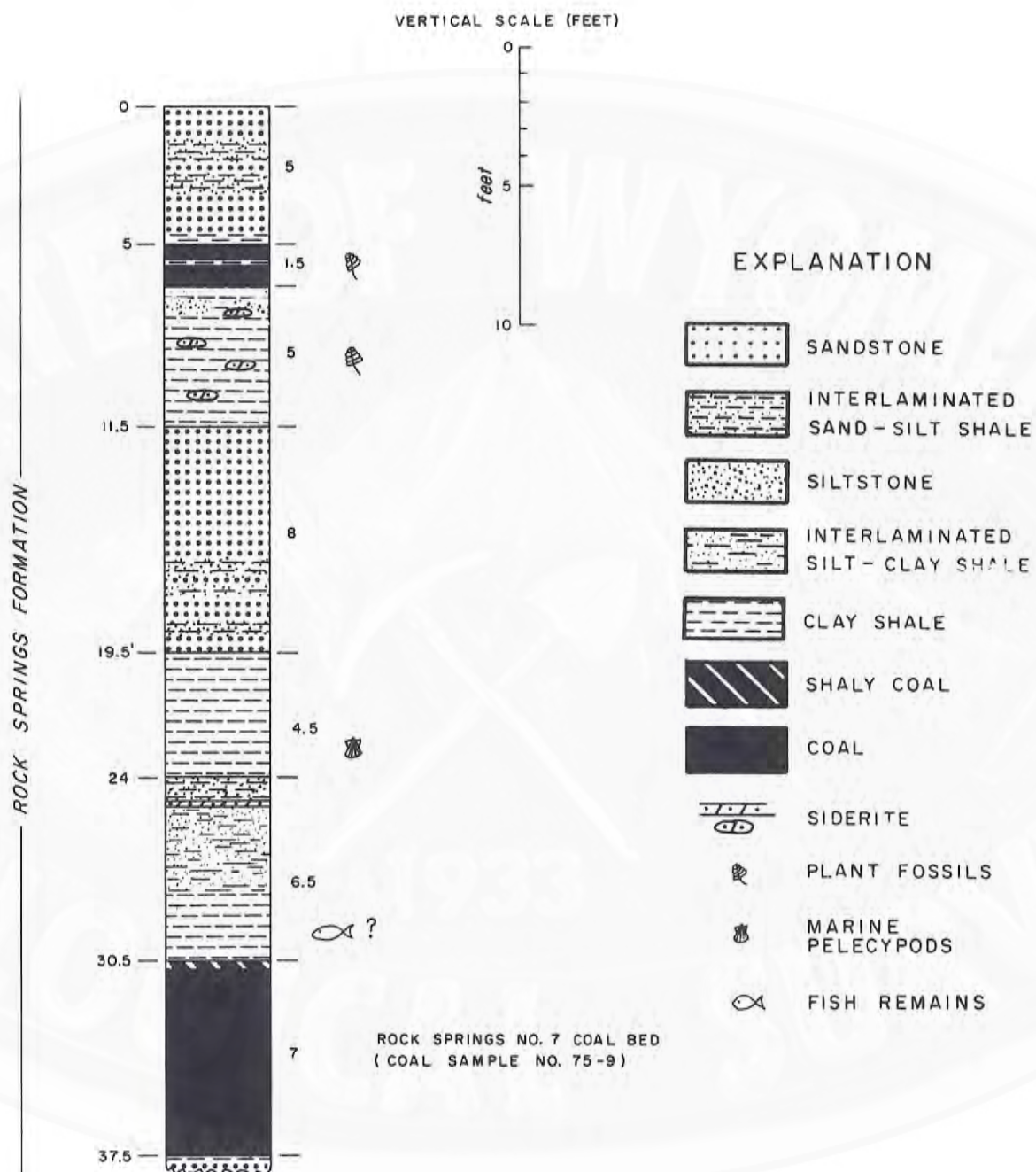
D177429

Moist, mineral-matter-free heat value: 12,285 Btu/pound

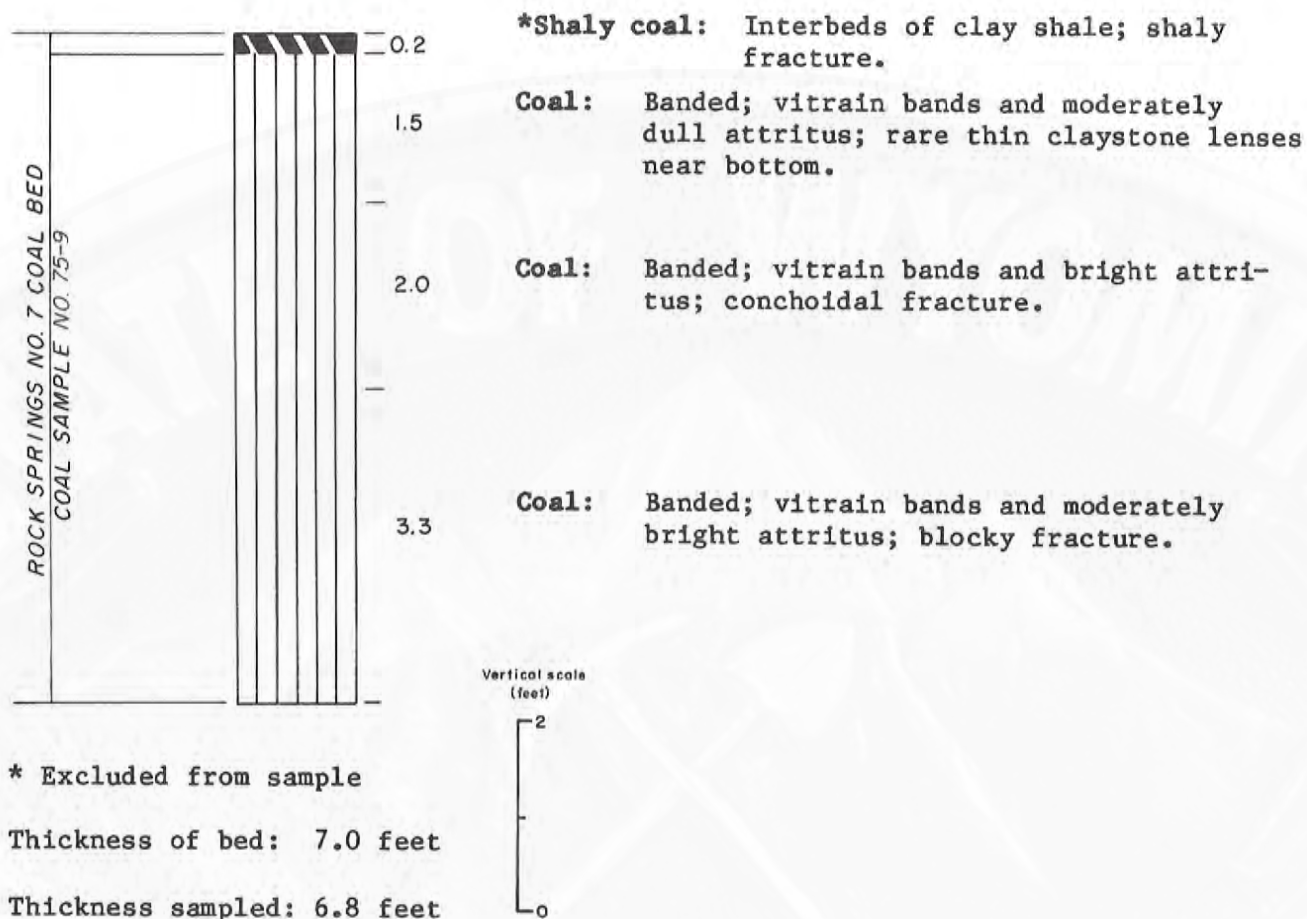
Apparent rank of coal: high volatile C bituminous

Miscellaneous comments: A sandstone-filled channel at least 300 feet wide is only 5 feet above the coal at the south end of the mine. The sandstone is about 30 to 40 feet thick; fine-grained at top; the channel axis tends approximately east-west.

Appendix B (continued). Measured section at the Rock Springs No. 7 coal bed sample site in the Colony No. 2 strip mine (sample number 75-9).



Appendix B (continued). Megascopic description of the Rock Springs No. 7 coal bed in the Colony No. 2 strip mine (sample number 75-9).



Appendix B (continued).

Sample number: 75-10

Coal name(s): Rock Springs No. 3(?)

State: Wyoming

Geologic formation: Rock Springs

County: Sweetwater

Age: Upper Cretaceous

Section: 2

Coal district: Rock Springs

Township: 18N

Coal field: Green River Basin

Range: 105W

Total section measured (feet): 78.6'

Quadrangle: Rock Springs 7 1/2-minute

Cover at sampling point (feet): 52.6'

Elevation top of sampled coal: 6,467 feet±

Thickness of coal (feet): 6.0

Strike: 26°

Thickness sampled (feet): 6.0

Dip: 6°NW

Type of sample: face-channel

Major joint orientations in coal:

Condition of sample: very weathered

none measured

Type of exposure: abandoned strip mine

Mine name: unknown

Date of sampling: 8/13/75

Sample collector: Geological Survey of Wyoming

Completion date of analyses

Laboratory numbers

U.S. Department of Energy: 2/5/76

K-58210

U.S. Geological Survey: 6/11/76

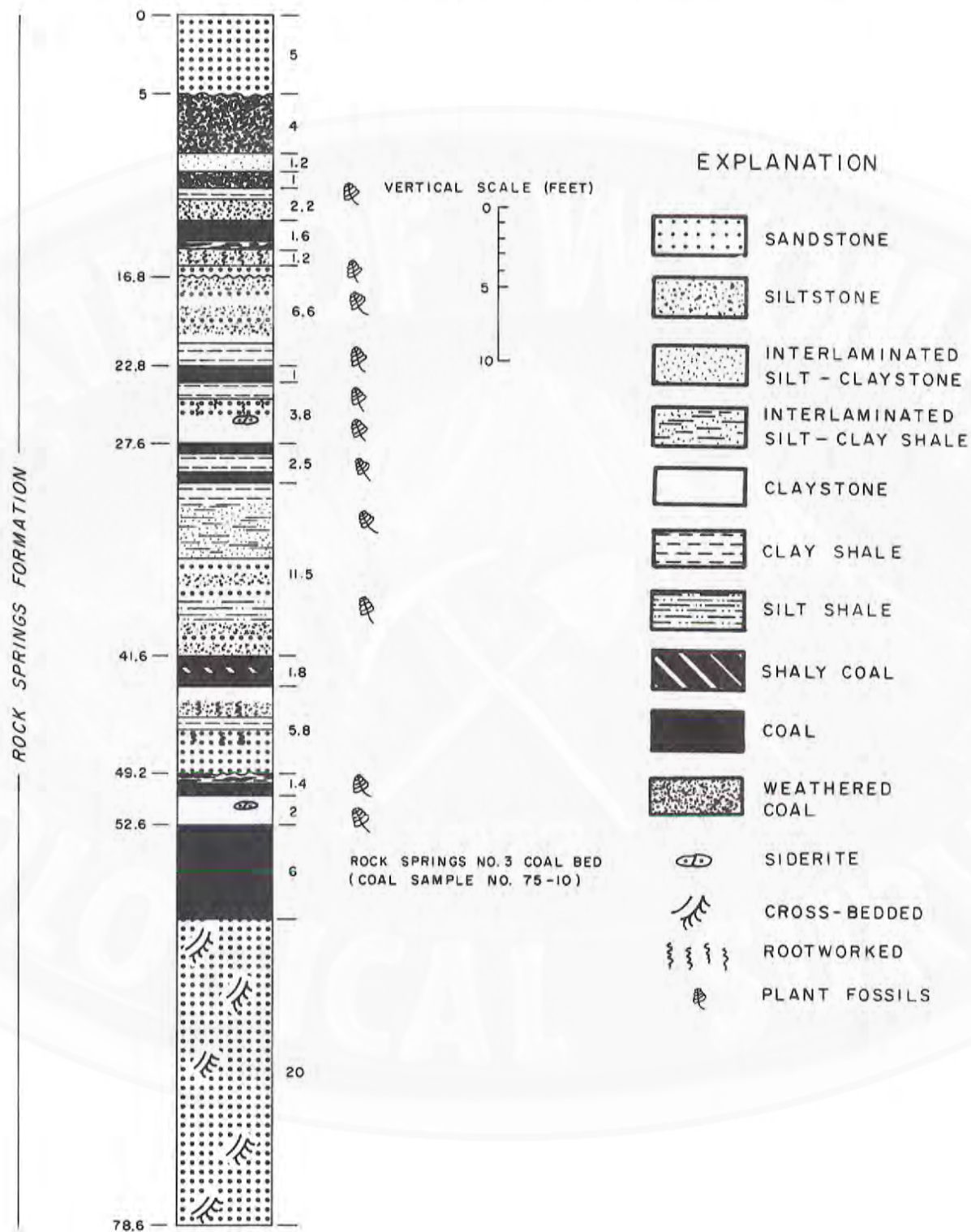
D177430

Moist, mineral-matter-free heat value: too weathered for accurate determination

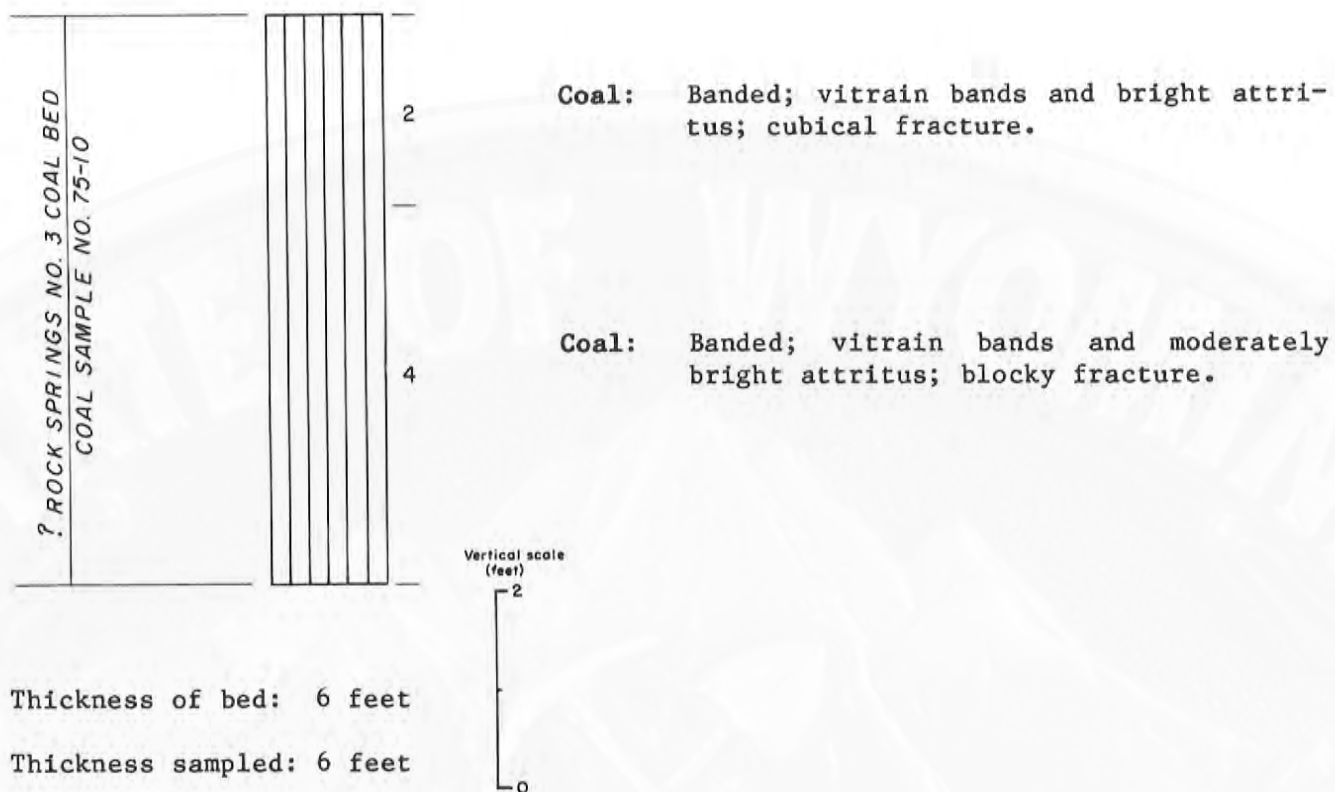
Apparent rank of coal: too weathered for determination of rank

Miscellaneous comments: none

Appendix B (continued). Measured section at the Rock Springs No. 3(?) coal bed sample site in an unnamed strip mine (sample number 75-10).



Appendix B (continued). Megascopic description of the Rock Springs No. 3(?) coal bed (sample number 75-10).



Appendix B (continued).

Sample number: 75-12

Coal name(s): Rock Springs No.1(?)

State: Wyoming

Geologic formation: Rock Springs

County: Sweetwater

Age: Upper Cretaceous

Section: 2

Coal district: Rock Springs

Township: 18N

Coal field: Green River Basin

Range: 105W

Total section measured (feet): 40

Quadrangle: Rock Springs 7 1/2-minute

Cover at sampling point (feet): 0

Elevation top of sampled coal: 6,520 feet±

Strike: 10°

Thickness of coal (feet): 11.0

Dip: 4°N

Thickness sampled (feet): 11.0

Major joint orientations in coal:
83-87°

Type of sample: face-channel

Condition of sample: slightly weathered

Type of exposure: roadcut

Date of sampling: 8/14/75

Sample collector: Geological Survey of Wyoming

Completion date of analyses

Laboratory numbers

U.S. Department of Energy: 2/5/76

K-58212

U.S. Geological Survey: 6/11/76

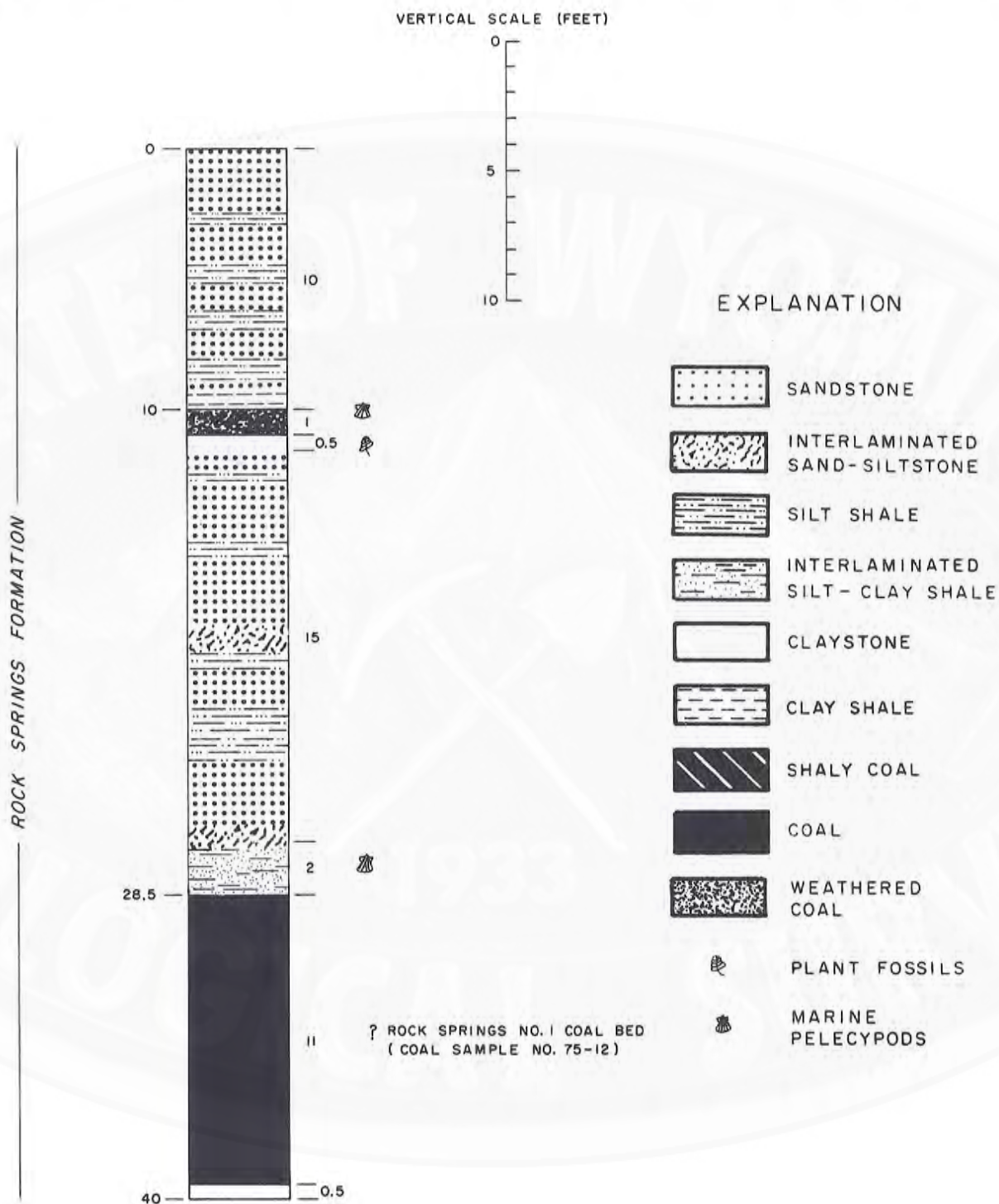
D177432

Moist, mineral-matter-free heat value: 11,990 Btu/pound

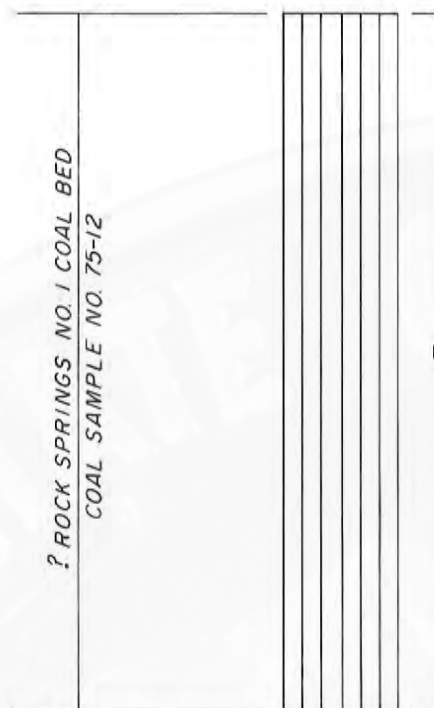
Apparent rank of coal: high volatile C bituminous

Miscellaneous comments: none

Appendix B (continued). Measured section at the Rock Springs No. 1 coal bed sample site (sample number 75-12).



Appendix B (continued). Megascopic description of the Rock Springs No. 1(?) coal bed (sample number 75-12).



Coal: Banded; vitrain bands and moderately bright attritus; some light brown claystone lenses up to 3 inches thick; a few dull shaly or claystone units near bottom.

Thickness of bed: 11 feet

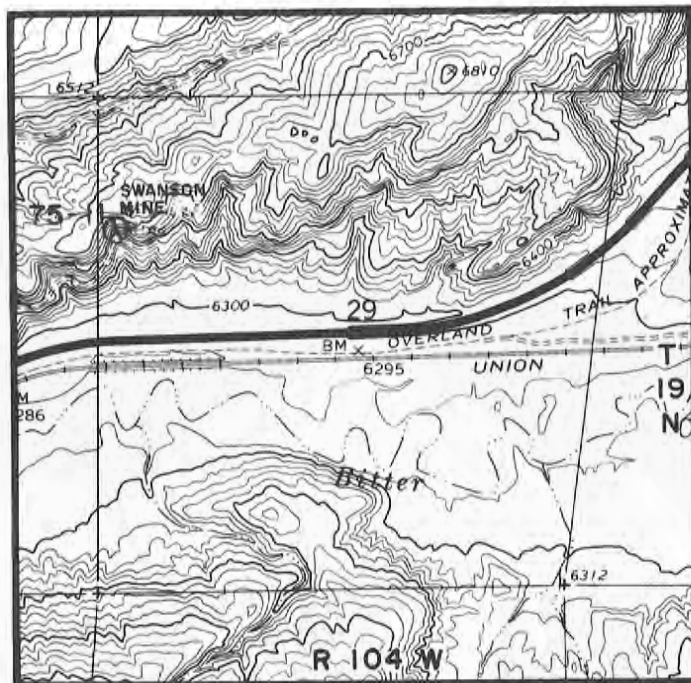
Thickness sampled: 11 feet

Vertical scale
(feet)



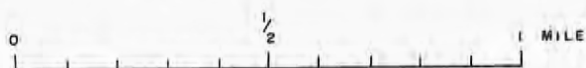
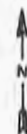
Appendix C

Appendix C. Detailed location map of sample number 75-11 at the Swanson deep mine.



EXPLANATION

⑦ 75-11 Sample site and sample number



Base map modified from U.S. Geological Survey's
Rock Springs (1968) 7 1/2' topographic map.

Appendix C (continued).

Sample number: 75-11

Coal name(s): Rock Springs No. 15
(Van Dyke seam)

Geologic formation: Rock Springs

Age: Upper Cretaceous

Coal district: Rock Springs

Coal field: Green River Basin

Total section measured (feet): 253.4

Cover at sampling point (feet): 0

Elevation top of sampled coal: 6,480 feet

Strike: 35°

Dip: 12°NW

Major joint orientations in coal:
71°, 0°

State: Wyoming

County: Sweetwater

Section: 29

Township: 19N

Range: 104W

Quadrangle: Rock Springs 7 1/2-minute

Thickness of coal (feet): 3.7

Thickness sampled (feet): 3.7

Type of sample: face-channel

Condition of sample: weathered

Type of exposure: outcrop

Mine name: Swanson (active deep mine)

Date of sampling: 8/14/75

Sample collector: Geological Survey of Wyoming

Completion date of analyses

U.S. Department of Energy: 2/5/76

U.S. Geological Survey: 6/11/76

Laboratory numbers

K-58211

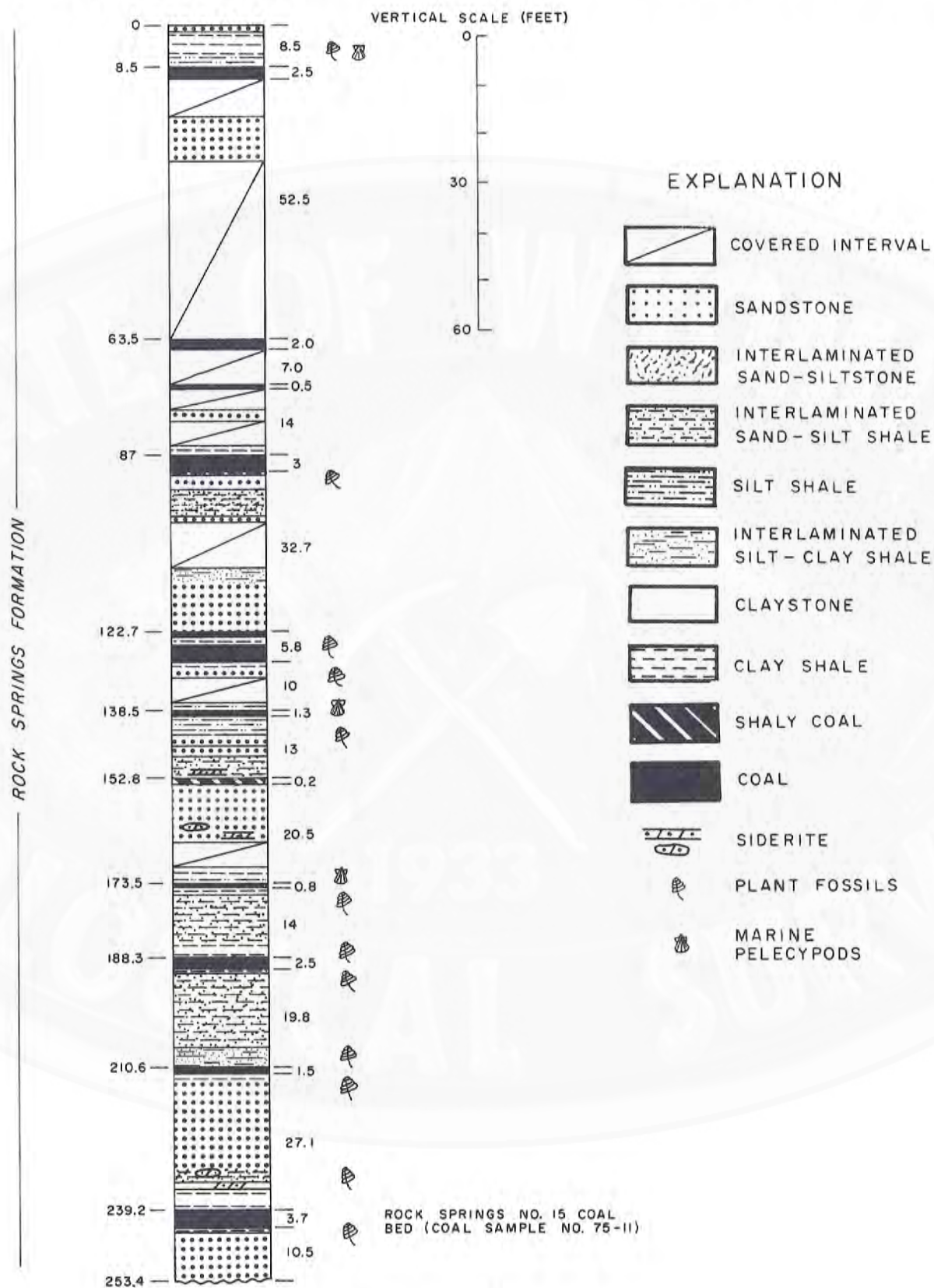
D177431

Moist, mineral-matter-free heat value: 12,000 Btu/pound

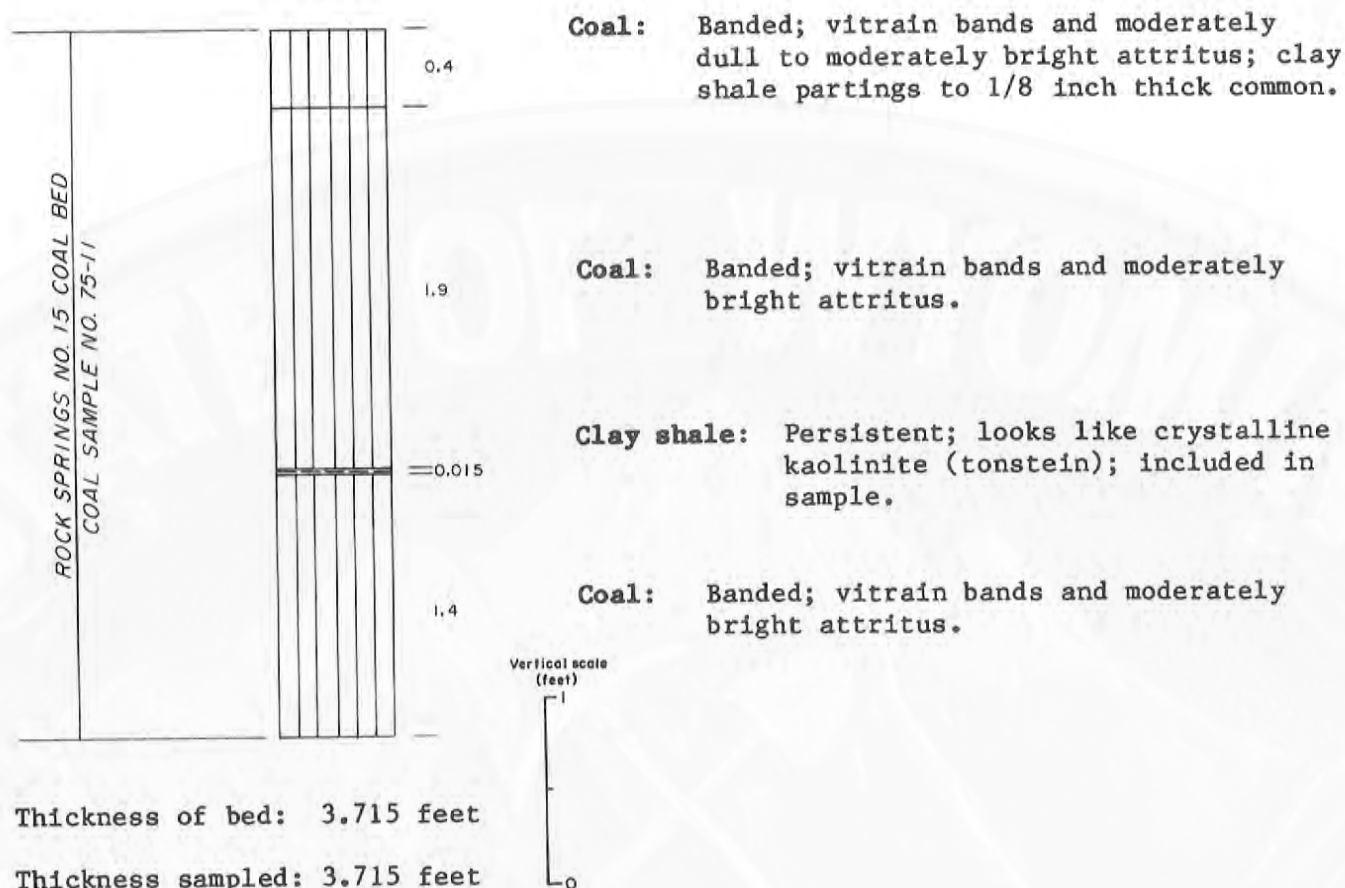
Apparent rank of coal: high volatile C bituminous

Miscellaneous comments: Section (Figure 15) measured on hillside immediately west of mine entrance. Coal sample collected on west face of main heading approximately 150 feet in from mine entrance.

Appendix C (continued). Measured section at the Rock Springs No. 15 coal bed sample site at the Swanson deep mine (sample number 75-11).

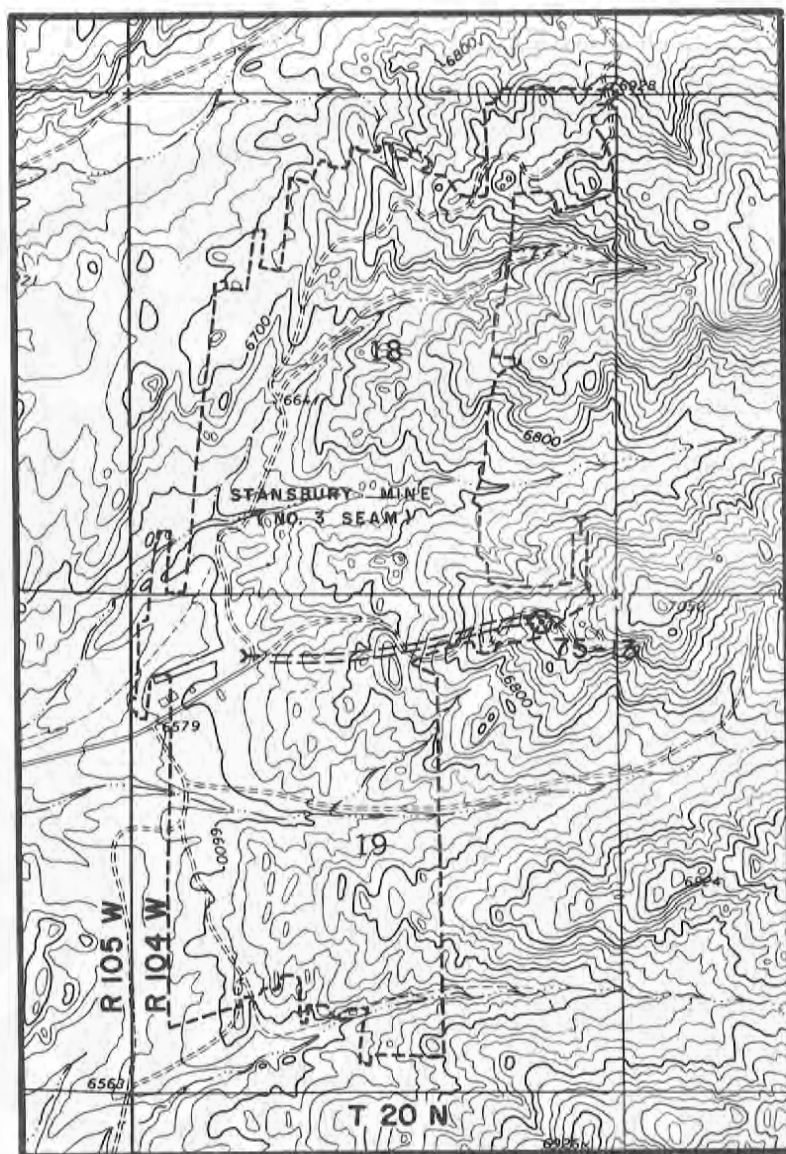


Appendix C (continued). Megascopic description of the Rock Springs No. 15 coal bed at the Swanson deep mine (sample number 75-11).



Appendix D

Appendix D. Detailed location map of coal sample number 75-13 in the Stansbury deep mine.

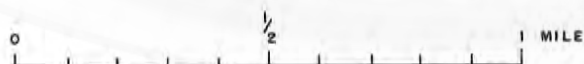


EXPLANATION

- 75-13 Underground sample site and sample number
- Limit of mine workings (NO. 3 seam)



Base map modified from U.S. Geological Survey's Reliance (1968) 7 1/2' topographic map.



Appendix D (continued).

Sample number: 75-13

Coal name(s): Rock Springs No. 3

State: Wyoming

Geologic formation: Rock Springs

County: Sweetwater

Age: Upper Cretaceous

Section: 19

Coal district: Rock Springs

Township: 20N

Coal field: Green River Basin

Range: 104W

Total section measured (feet): 11.0

Quadrangle: Reliance 7 1/2-minute

Cover at sampling point (feet): 300

Elevation top of sampled coal: 6,601 feet

Strike: 350°

Thickness of coal (feet): 8+

Dip: 11°SW

Thickness sampled (feet): 6.8

Major joint orientations in coal:

296°, 317°

Type of sample: face-channel

Condition of sample: slightly weathered

Type of exposure: deep mine

Mine name: Stansbury

Date of sampling: 8/15/75

Sample collector: Geological Survey of Wyoming

Completion date of analyses

Laboratory numbers

U.S. Department of Energy: 2/5/76

K-58213

U.S. Geological Survey: 6/11/76

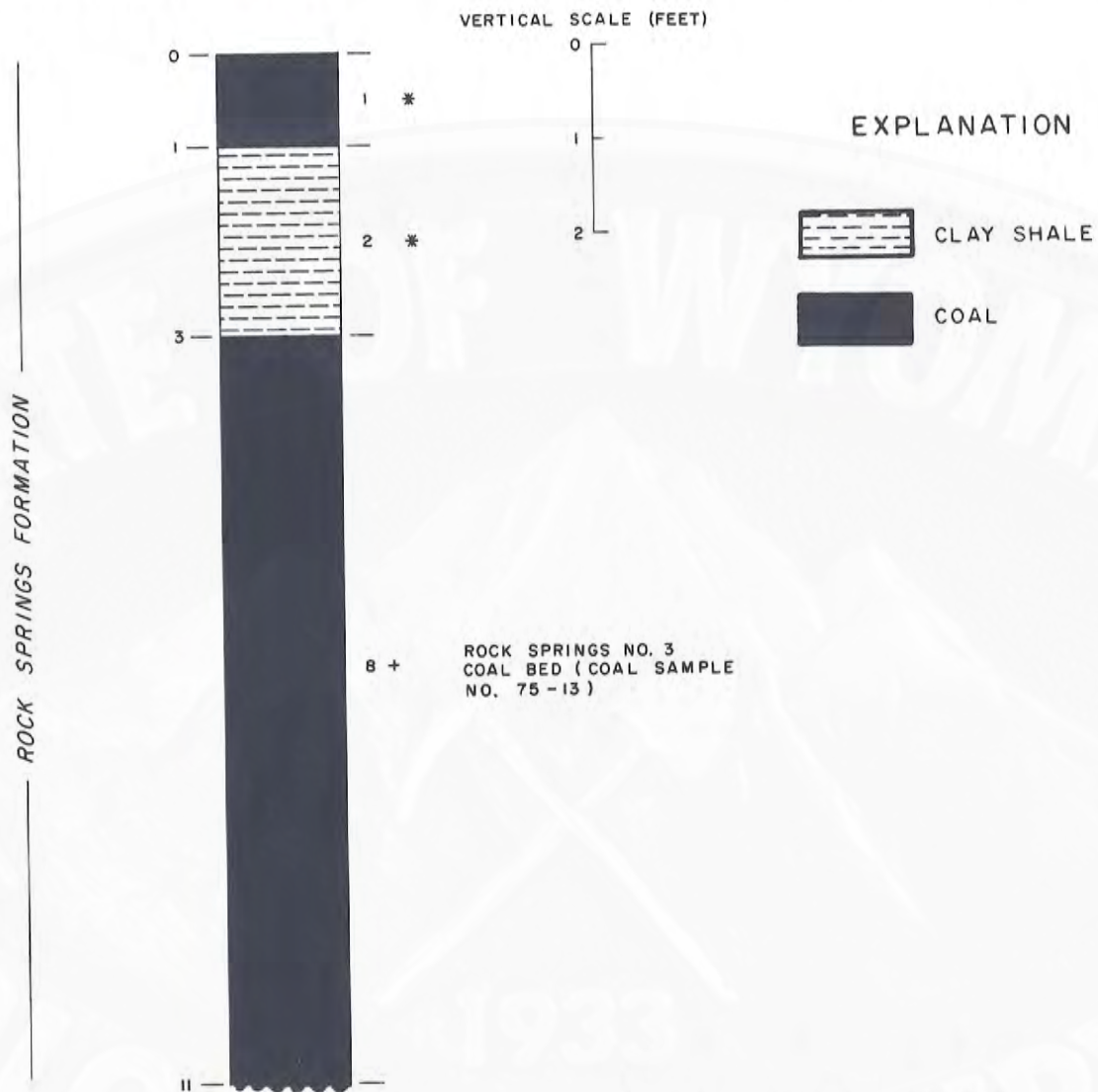
D177433

Moist, mineral-matter-free heat value: 10,785 Btu/pound

Apparent rank of coal: high volatile C bituminous

Miscellaneous comments: Company plans to mine the top 6.8 feet. Bottom of seam not exposed. Sample collected along old slope to No. 3 Bed. Mine now closed.

Appendix D (continued). Measured section at the Rock Springs No. 3 coal bed sample site in the Stansbury mine (sample number 75-13).



* Not actually seen, derived from drill hole information.

Appendix D (continued). Megascopic description of the Rock Springs No. 3 coal bed in the Stansbury deep mine (sample number 75-13).

