DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

Chemical Analyses for Nine Coal Samples from the Sagwon Member (Tertiary) of the Sagavanirktok Formation, North Slope, Alaska

by

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Open-File Report 88-678

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

[1]Denver, Colorado

1988

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INTRODUCTION

In July of 1985 and 1986, the U.S. Geological Survey conducted a small-scale coal investigation at Sagwon Bluffs, near Sagwon, Alaska, which is about 66 mi south of Prudhoe Bay on the Sagavanirktok River (fig. 1). This report presents the analytical results for nine coal samples collected by the authors from outcrops at Sagwon Bluffs. Figure 2 shows the approximate locations of the collected coal samples, which were fresh (trenched to permafrost) channel samples (fig. 3).

The U.S. Geological Survey analyzed each coal sample for major, minor, and trace elements. Figure 4 schematically portrays the procedures for analysis in the Reston, Virginia, laboratory. Supplemental samples of the roof and floor rock and major partings were also collected at coal sample sites, but were not analyzed due to budgetary limits. Proximate and ultimate analyses for these coal samples will be available in the future.

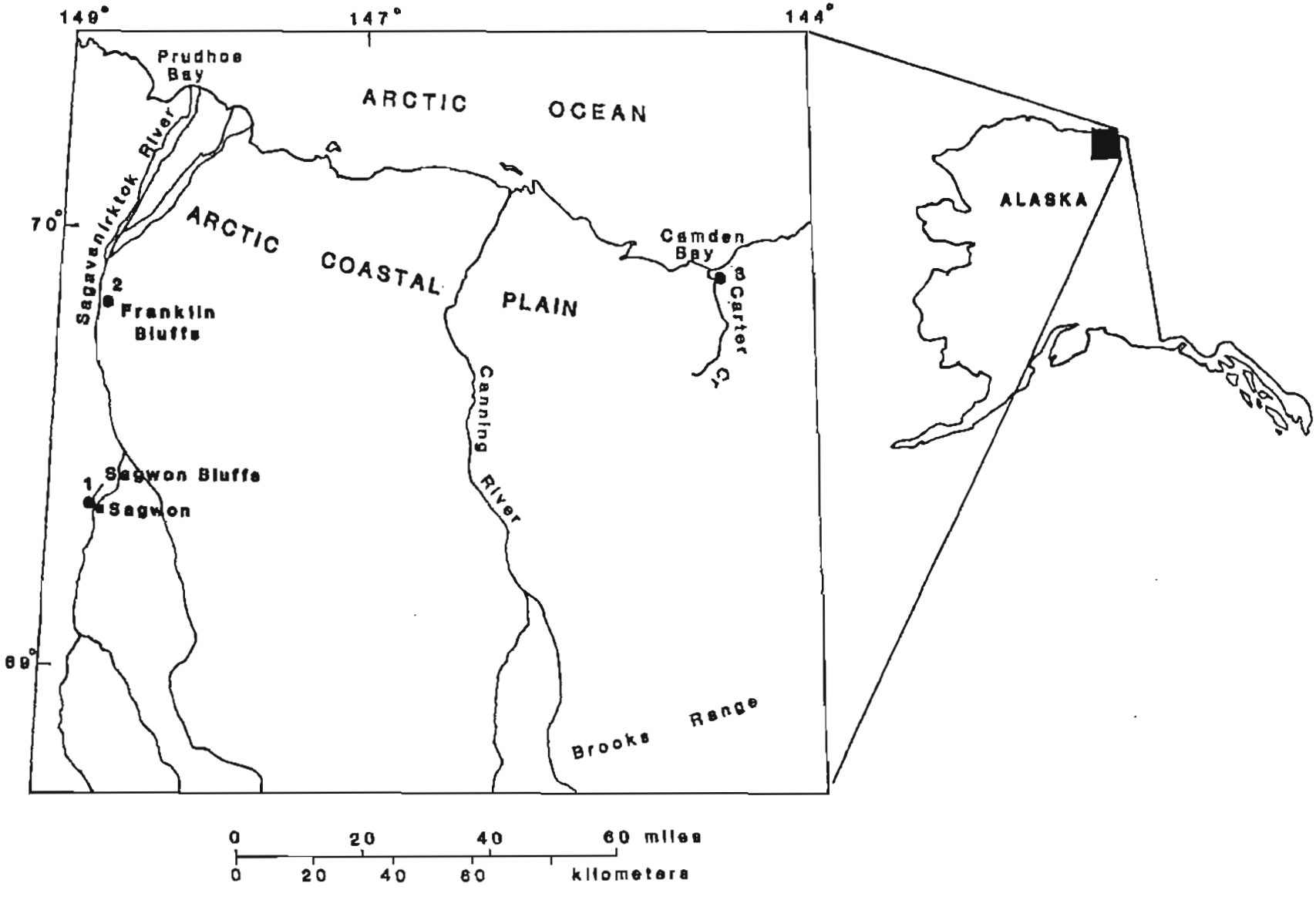

Figure 1. Map showing the study area at Sagwon Bluffs (no. 1) near Sagwon, Franklin Bluffs (no. 2), and Carter Creek (no. 3) on the North Slope, Alaska (Modified from Detterman and others, 1975, p. 3).

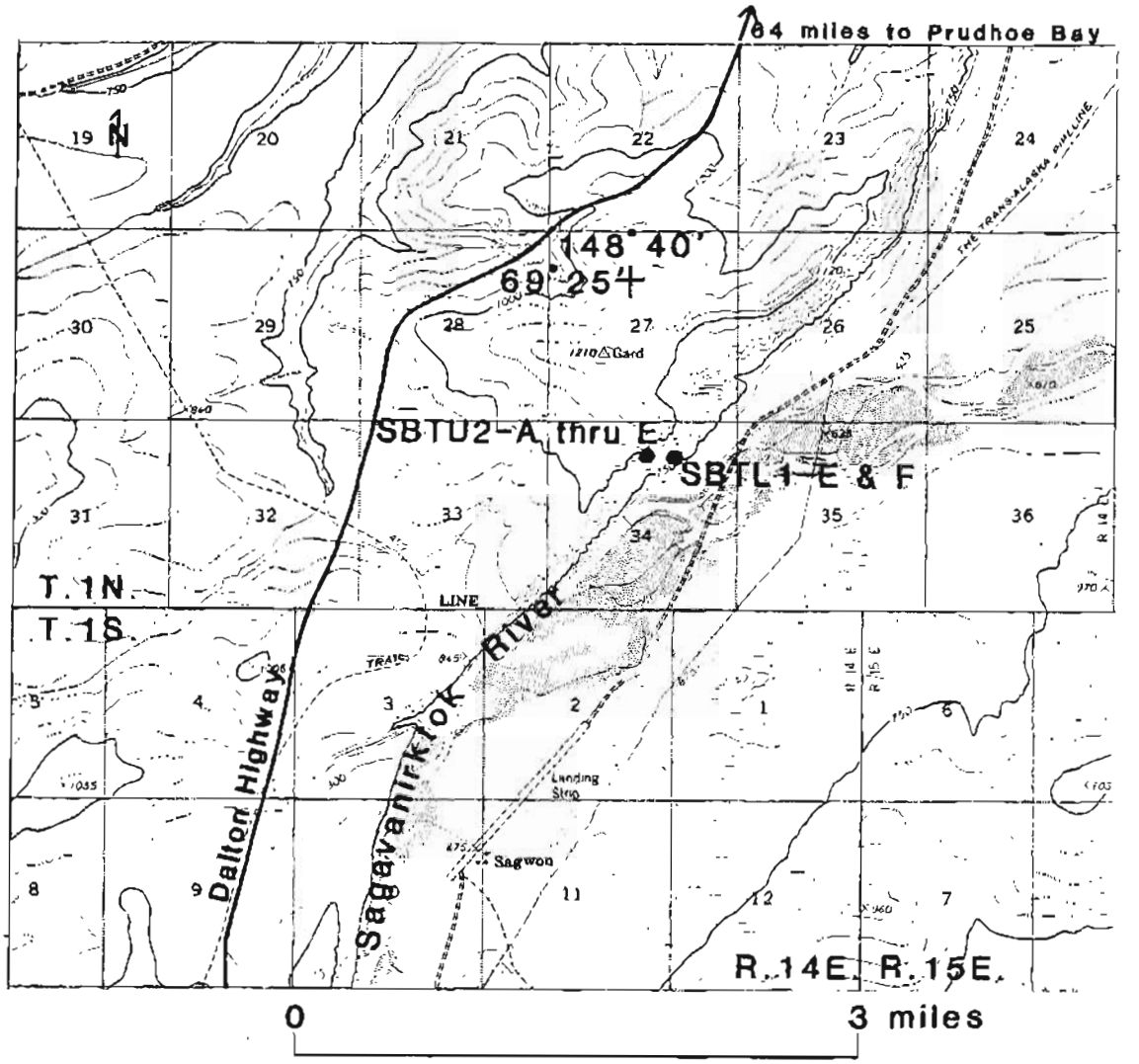

Figure 2. Map showing the approximate locations of collected coal samples from the outcrop exposing the Sagwon Member of the Sagavanirktok Fm. at Sagwon Bluffs in sec. 34, T. 1 N., R. 14 E. Scale 1:63,360. (Modified from the Sagavanirktok (B-3), Alaska 15' quadrangle).

Figure 3. Photograph of a deeply trenched coal channel at Sagwon Bluffs exposing "frozen coal." All coal outcrop samples were collected from trenches like this.

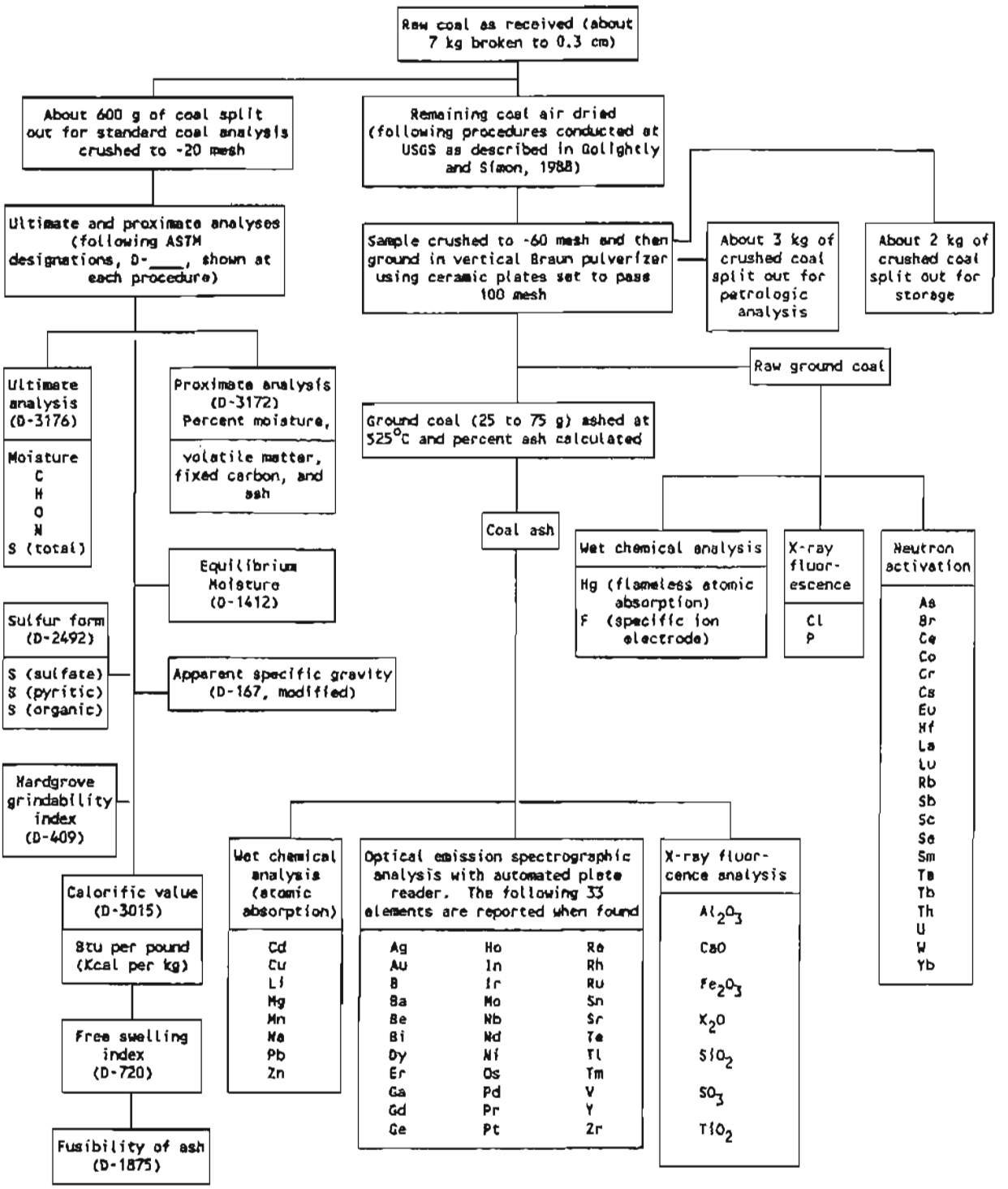

Figure 4. Flow diagram for coal sample analysis in the U.S. Geological Survey's Reston, Virginia lab. (ASTM-American Society for Testing and Materials, U.S. Bureau of Mines, U.S. Dept. of Energy, GT-Geochemical Testing Company, USGS-U.S. Geological Survey)(Modified from Swanson and Huffman, 1976)

GEOLOGIC SETTING

Gryc and others (1951) named the Sagavanirktok Formation for a sequence of siltstone, sandstone, conglomerate, and lignite exposed at Franklin Bluffs, which is north of Sagwon on the Sagavanirktok River (fig. 1). Due to considerable confusion surrounding the stratigraphic limits of the formation, Detterman and others (1975) included all beds above the Cretaceous Prince Creek Formation and below the Quaternary Gubik Formation in the Sagavanirktok Fm (fig. 5). They also divided the formation into three formal members: in ascending order, the Sagwon, Franklin Bluffs, and Nuwok Members. Each member has a unique location for its type section, as no single exposure of the Sagavanirktok Fm. contains a complete sequence (fig. 5). Sagwon (no. 1, fig. 5) and Franklin Bluffs (no. 2) are the respective locations for the lower two members. Carter Creek (no. 3) is the type locality for the Nuwok Member.

The Sagwon Member is the only member of the formation that contains coal. The type section, 143 m (470 ft) thick (no. 1, fig. 5), starts on the west side of the Sagavanirktok River and continues south for about 1.6 km (1 mi) along the bluff. It consists of shale, siltstone, sandstone, conglomerate, carbonaceous shale, and lignite (Detterman and others, 1975). Detterman and others (1975) also reported that crossbedding of the shallow-water to deltaic type is common in both sandstone and conglomerate and indicates a source area to the southwest. Limited spore-pollen assemblages in four samples from above and below the two major coal units suggest a restricted lowland, nonmarine environment with relatively little detrital material influx. The low diversity palynomorphs found are:

Upper coal - roof sample	Middle coal - roof sample
Laevigatosporites sp.	Deltoidospora sp.
Sphagnumsporites sp.	Osmundacidites sp.
Alnipollenites sp.	Alnipollenites sp.
Paraalnipollenites confusus	Cicatricosisporites sp.
floor sample	floor sample
Laevigatosporites sp.	Deltoidospora sp.
Alnipollenites sp.	Lycopodiumsporites sp.
?Paraalnipollenites confusus	Alnipollenites sp.
	?Cicatricosisporites sp.
	Multicellaesporites sp. (fungal spore)
	?Microthyriacites sp. (fungal spore)

Fossil flora date the member as Paleocene in age. The lower contact of the Sagwon Member with the underlying Cretaceous Prince Creek Fm. is conformable. Both the upper Prince Creek Fm. and the Sagwon Member contain coal and consist of poorly consolidated rock. However, the coal of the Prince Creek is thought to be a higher rank (Detterman and others, 1975). The upper contact with terrace gravel is unconformable.

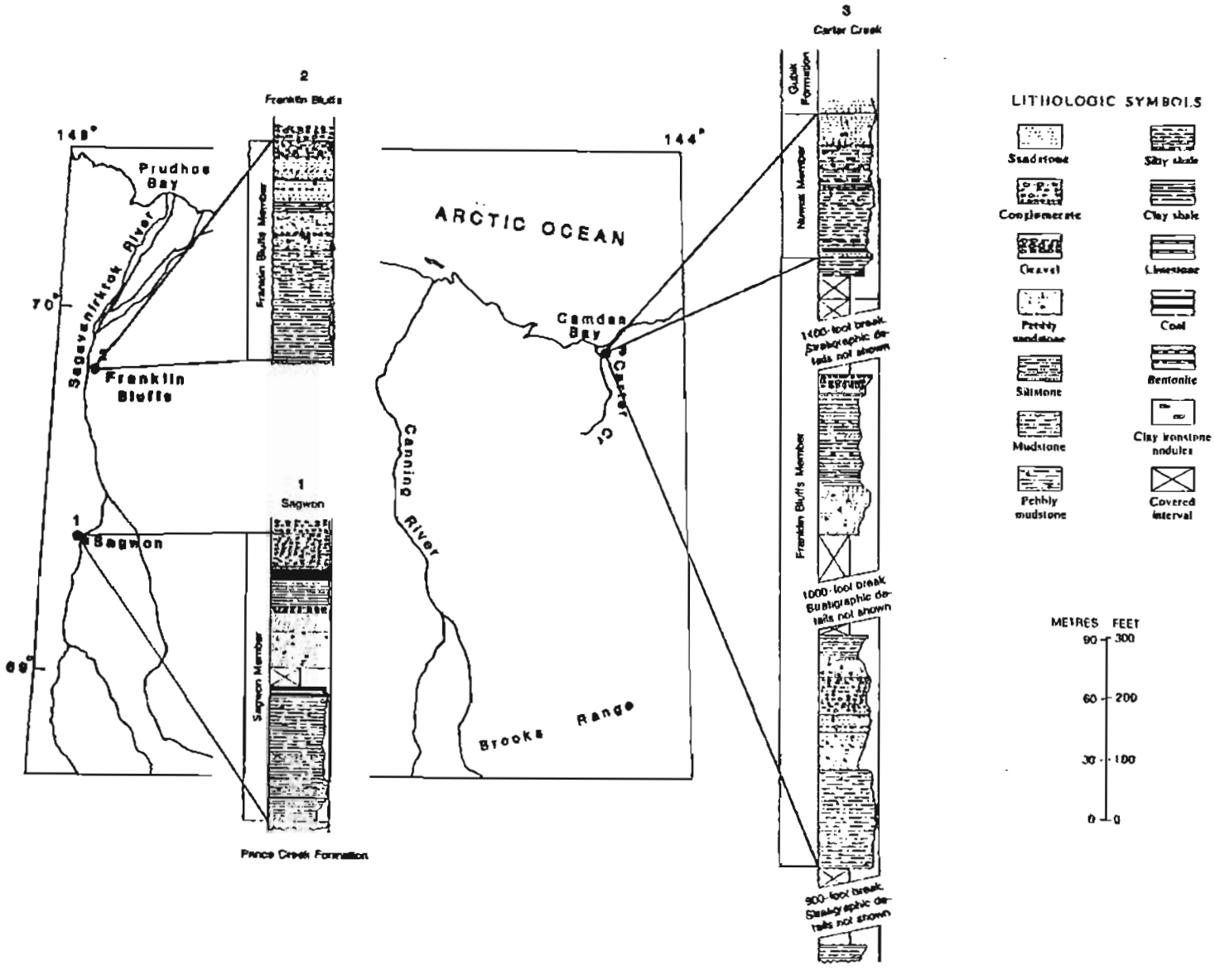

Figure 5. Map showing the unique locations of the type sections for each member of the Sagavanirktok Fm. and stratigraphic column: 1) Sagwon Member at Sagwon, 2) Franklin Bluffs Member at Franklin Bluffs, and 3) Nuwok Member at Carter Creek. (Modified from Detterman and others, 1975, p. 38)

COAL SAMPLES AND ANALYSES

Samples SAG2-11-1 and SAG2-19-2 are grab samples collected in 1985 and represent the middle and upper coal beds, respectively. Samples SBTL1-E and F and SBTU2-A through E also represent the middle and upper coal beds collected in 1986 at Sagwon Bluffs. The 1986 samples are continuous channel samples taken from deeply trenched exposures similar to the one shown in figure 3 and correspond to drill holes #10 (middle coal) and #7 (upper coal), as reported by Roberts and others (1988).

The USGS Analytical Lab assigns its own sample number to each coal sample with no reference to the collector's field id. The list on page 9 equates the field id, assigned sample number, and other descriptive information about the nine coal samples, such as latitude/longitude, name of coal bed, sampled thickness, etc.

All data in tables 1, 2, and 3 are reported by the assigned sample number, not the field id: Table 1 lists oxide data on an ash basis; Table 2 lists trace element data on whole-coal basis; and Table 3 lists major, minor, and trace element composition on whole-coal basis. Tables 4a and 4b are statistical listings for trace elements and oxides for the nine coal samples.

DESCRIPTIVE INFORMATION FOR 9 COAL SAMPLES FROM ALASKA.

Field ID	Sample No.	State	County	Latitud	Longitud	Formation	Coal Bed	Rank	Sample Type	Sampled Thickness (inches)
SAG2-11-1	W233091	Alaska	North Slope	692432N	1483915W	Sagavanirktok	Unnamed	Lignite	Grab	1.5
SAG2-19-2	W233092	Alaska	North Slope	692432N	1483915W	Sagavanirktok	Unnamed	Lignite	Grab	1.0
SBTU2-A	W238497	Alaska	North Slope	692414N	1484021W	Sagavanirktok	Upper	Lignite	Channel	1.5
SBTU2-B	W238498	Alaska	North Slope	692414N	1484021W	Sagavanirktok	Upper	Lignite	Channel	1.1
SBTU2-C	W238499	Alaska	North Slope	692414N	1484021W	Sagavanirktok	Upper	Lignite	Channel	0.5
SBTU2-D	W238500	Alaska	North Slope	692414N	1484021W	Sagavanirktok	Upper	Lignite	Channel	1.5
SBTU2-E	W238501	Alaska	North Slope	692414N	1484021W	Sagavanirktok	Upper	Lignite	Channel	0.9
SBTL1-E	W238502	Alaska	North Slope	692413N	1484003W	Sagavanirktok	Middle	Lignite	Channel	1.5
SBTL1-F	W238503	Alaska	North Slope	692413N	1484003W	Sagavanirktok	Middle	Lignite	Channel	1.0

Table 1.--Major and minor oxide and trace element composition of the laboratory ash of 9 lignite samples from Alaska.

[Values in percent or parts-per-million. Coal ashed at 525 C. L means less than the value shown
N= not determined: S after element title indicates determination by automatic plate reading computer assisted, emission spectrographic analyses. The standard deviation of any single answer should be taken as plus 50% and minus 35%.]

SAMPLE NUMBER	ASH (PERCENT)	SIO2 (PERCENT)	AL2O3 (PERCENT)	CAO (PERCENT)	MGO (PERCENT)	NA2O (PERCENT)	K2O (PERCENT)	FE2O3 (PERCENT)	TIO2 (PERCENT)	P2O5 (PERCENT)	SAMPLE NUMBER
W233091	9.6	33	21	16	5.0	0.51	1.6	4.6	0.94	3.3	W233091
W233092	7.1	19	28	11	2.2	.04	.24	13	.50	11	W233092
W238497	2.6	13	9.2	13	3.6	.05	.36	36	.33	.38L	W238497
W238498	3.2	13	10	14	1.3	.03L	.37	34	.35	.31L	W238498
W238499	19.9	3.0	1.9	3.2	2.0	.03L	.06	74	.05	.11	W238499
W238500	4.5	13	17	12	2.8	.03L	.12	24	.50	9.0	W238500
W238501	3.1	21	29	8.7	1.4	.04	.39	11	.77	13	W238501
W238502	12.9	42	28	6.0	2.5	.34	1.7	3.7	1.0	.26	W238502
W238503	15.4	48	29	4.9	2.7	.43	2.4	3.4	.99	.065L	W238503

SAMPLE NUMBER	SO3 (PERCENT)	AG-S PPM	B-S PPM	BA-S PPM	BE-S PPM	CD PPM	CE PPM	CO PPM	CR PPM	CS PPM	SAMPLE NUMBER
W233091	6.2	0.70	450	27,000	4.3	0.20L	100	60	110	5.3	W233091
W233092	4.5	1.1	520	28,000	7.7	.20L	180	130	75	.69	W233092
W238497	44	.10L	520	10,000	29	.64	180	350	50	3.5L	W238497
W238498	32	.10L	510	18,000	4.9	.50	41	160	34	1.7	W238498
W238499	9.5	.10L	120	3,900	1.5L	.50	7.0	26	11	.72	W238499
W238500	31	.10L	520	22,000	8.8	.40	99	130	28	1.8L	W238500
W238501	17	.10L	380	22,000	6.1	.20	160	75	73	1.5	W238501
W238502	20	1.2	530	13,000	6.6	.20	98	31	150	9.6	W238502
W238503	14	.85	490	7,700	11	.20	100	40	170	11	W238503

SAMPLE NUMBER	CU PPM	EU PPM	GA-S PPM	GE-S PPM	HF PPM	LA PPM	LI PPM	LU PPM	MN PPM	MO-S PPM	SAMPLE NUMBER
W233091	80	3.9	21	4.6L	5.2	59	27	1.0	550	28	W233091
W233092	35	3.6	13	5.8	4.2	100	30	.7	2,100	20	W233092
W238497	90	7.2	8.2	4.6L	2.2	85	13	1.8	5,700	79	W238497
W238498	83	1.0	9.7	4.6L	2.7	27	5.0	.3L	5,300	3.2L	W238498
W238499	17	.10	16	4.6L	1.0L	4.9	5.0	.0L	8,000	9.4	W238499
W238500	47	1.2	23	4.6L	5.7	63	5.0	.5	3,300	3.2L	W238500
W238501	37	2.2	39	4.6L	5.3	100	12	.8	1,000	15	W238501
W238502	140	2.4	54	4.6L	5.1	58	42	.7	250	16	W238502
W238503	160	3.0	57	4.6L	5.1	58	38	.9	250	15	W238503

Table 1.--Major and minor oxide and trace element composition of the laboratory ash of 9 lignite samples from Alaska.--continued

SAMPLE NUMBER	NB-S PPM	NO-S PPM	NI-S PPM	PB PPM	PR-S PPM	RB PPM	SC PPM	SM PPM	SN-S PPM	SR-S PPM	SAMPLE NUMBER
W233091	24	44	130	54	100L	420L	41	17	21	3,600	W233091
W233092	13	120	310	92	100L	320L	21	20	22	3,200L	W233092
W238497	5.8	200	520	31	23	230L	11	32	36	830	W238497
W238498	19	52	420	9.0	10	190L	8.6	3.8	46	1,100	W238498
W238499	11	32L	110	5.0	15	45L	1.1	.64	78	280	W238499
W238500	22	74	320	12	16	100L	9.7	7.5	57	15,000	W238500
W238501	17	110	200	41	19	74L	22	14	25	12,000	W238501
W238502	17	97	71	26	9.5	71	37	11	17	780	W238502
W238503	7.3	72	99	34	8.4	120	43	14	27	620	W238503

SAMPLE NUMBER	TA PPM	TE PPM	TH PPM	U PPM	V-S PPM	W PPM	Y-S PPM	YB PPM	ZN PPM	ZR-S PPM	SAMPLE NUMBER
W233091	0.9	2.2	17	4.8	240	2.8	100	6.9	90	240	W233091
W233092	.6	2.1	11	3.5L	140	2.1	88	5.8	54	210	W233092
W238497	2.7L	4.8	5.6	6.9L	42	4.2	150	15	230	100	W238497
W238498	1.0	.53	5.4	5.3L	61	3.1L	38	3.3	130	180	W238498
W238499	.5L	.30L	.7	.81L	7.7	1.0L	1.5L	.38	140	63	W238499
W238500	1.4	1.0	19	7.6	28	2.2	52	3.8	80	320	W238500
W238501	1.1	1.5	13	5.9	130	3.8	77	6.7	25	320	W238501
W238502	1.2	1.3	14	4.7	390	2.6	70	5.6	23	260	W238502
W238503	1.2	1.9	18	4.0	430	2.6	93	7.1	24	270	W238503

Table 2.--Content of 23 trace elements in 9 lignite samples from Alaska.

[Analysis performed on whole-coal. Values in parts-per-million (ppm). L=less than the value shown; B = not determined.]

SAMPLE NUMBER	AS PPM	BA PPM	CE PPM	CL PPM	CO PPM	CR PPM	CS PPM	EU PPM	F PPM	HF PPM	SAMPLE NUMBER
W233091	1.5	1.3	10	100L	5.7	11	0.51	0.38	670	0.50	W233091
W233092	.96	1.2	13	100L	9.0	5.3	.05	.26	560	.30	W233092
W238497	.65	31	4.7	120	9.0	1.3	.09L	.19	20L	.06	W238497
W238498	.51	28	1.3	100L	5.1	1.1	.05	.03	20L	.09	W238498
W238499	.64	13	1.4	100L	5.1	2.1	.14	.02	30	.20L	W238499
W238500	.79	11	4.9	100L	6.4	1.4	.09L	.06	50	.28	W238500
W238501	.81	4.2	13	100L	6.1	5.9	.12	.18	140	.43	W238501
W238502	2.5	2.2	17	100L	4.0	19	1.2	.31	80	.66	W238502
W238503	3.1	12	16	100L	6.1	27	1.7	.46	70	.79	W238503

SAMPLE NUMBER	HG PPM	LA PPM	LU PPM	NA PPM	P PPM	RB PPM	SB PPM	SC PPM	SE PPM	SM PPM	SAMPLE NUMBER
W233091	0.010	5.7	0.094	360	1,400	40L	0.21	3.9	0.35	1.7	W233091
W233092	.010	7.4	.049	21	3,500	23L	.10	1.5	.27	1.5	W233092
W238497	.010	2.2	.047	10	44L	6.0L	.05	.29	.25	.83	W238497
W238498	.005L	.85	.010L	6.4L	44L	6.0L	.03	.27	.26	.12	W238498
W238499	.005L	.99	.009L	40L	96	9.0L	.03	.22	.90L	.13	W238499
W238500	.005L	3.1	.024	9.8L	1,900	5.0L	.06	.48	.59	.37	W238500
W238501	.005L	8.2	.064	24	4,500	6.0L	.10	1.8	.30L	1.1	W238501
W238502	.005L	7.5	.086	320	150	9.1	.29	4.8	.60L	1.5	W238502
W238503	.005L	9.0	.13	490	44L	19	.39	6.7	.51	2.1	W238503

SAMPLE NUMBER	TA PPM	TB PPM	TH PPM	U PPM	W PPM	YB PPM	SAMPLE NUMBER
W233091	0.084	0.22	1.2	0.46	0.27	0.66	W233091
W233092	.046	.15	.77	.25L	.15	.41	W233092
W238497	.070L	.13	.15	.18L	.11	.38	W238497
W238498	.031	.02	.17	.17L	.10L	.11	W238498
W238499	.10L	.06L	.14	.16L	.20L	.08	W238499
W238500	.067	.05	.94	.37	.11	.19	W238500
W238501	.089	.12	1.0	.48	.30	.54	W238501
W238502	.16	.16	1.8	.60	.33	.72	W238502
W238503	.19	.29	2.7	.62	.40	1.1	W238503

Table 3.--Major, minor, and trace element composition of 9 lignite samples from Alaska reported on whole-coal basis.

(Values in percent or parts-per-million. 22 values are from direct determinations on whole-coal; all other values calculated from analysis of 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)	AG-S PPM	AS PPM	SAMPLE NUMBER
W233091	1.5	1.1	1.1	0.29	0.036	0.13	0.31	0.054	0.067	1.5	W233091
W233092	.65	1.1	.56	.092	.002	.014	.67	.021	.078	.86	W233092
W238497	.16	.13	.24	.057	.001	.008	.66	.005	.003L	.65	W238497
W238498	.19	.18	.31	.025	.001L	.010	.76	.007	.003L	.51	W238498
W238499	.26	.20	.46	.24	.004L	.014	10	.006	.020L	.64	W238499
W238500	.29	.43	.43	.083	.001L	.005	.82	.015	.005L	.79	W238500
W238501	.78	1.2	.50	.070	.002	.026	.63	.037	.008L	.81	W238501
W238502	2.5	1.9	.55	.19	.032	.18	.34	.077	.15	2.5	W238502
W238503	3.4	2.4	.54	.23	.049	.31	.37	.091	.13	3.1	W238503

SAMPLE NUMBER	B-S PPM	BA-S PPM	BE-S PPM	BR PPM	CD PPM	CE PPM	CL PPM	CO PPM	CR PPM	CS PPM	SAMPLE NUMBER
W233091	62	2,600	0.41	1.3	0.019L	10	100L	5.7	11	0.51	W233091
W233092	37	2,000	.55	1.2	.014L	13	100L	9.0	5.3	.05	W233092
W238497	14	240	.75	31	.017	4.7	120	9.0	1.3	.09L	W238497
W238498	16	580	.16	28	.016	1.3	100L	5.1	1.1	.05	W238498
W238499	24	770	.30L	13	.099	1.4	100L	5.1	2.1	.14	W238499
W238500	25	1,100	.43	11	.020	4.9	100L	6.4	1.4	.09L	W238500
W238501	31	1,200	.49	4.2	.016	13	100L	6.1	5.9	.12	W238501
W238502	65	1,700	.85	2.2	.026	13	100L	4.0	19	1.2	W238502
W238503	75	1,200	1.7	12	.031	16	100L	6.1	27	1.7	W238503

SAMPLE NUMBER	CU PPM	SL PPM	F PPM	GA-S PPM	GE-S PPM	HF PPM	HG PPM	LA PPM	LI PPM	LL PPM	SAMPLE NUMBER
W233091	7.7	0.38	670	2.0	0.44L	0.50	0.010	5.7	2.6	0.09	W233091
W233092	2.5	.26	560	.92	.41	.30	.010	7.4	2.1	.05	W233092
W238497	2.3	.19	20L	.21	.12L	.06	.010	2.2	.34	.05	W238497
W238498	2.7	.03	20L	.31	.15L	.09	.005L	.85	.16	.01L	W238498
W238499	3.4	.02	30	3.2	.91L	.20L	.005L	.98	.99	.01L	W238499
W238500	2.3	.06	50	1.1	.23L	.28	.005L	3.1	.25	.02	W238500
W238501	3.0	.19	140	3.2	.37L	.43	.005L	8.2	.97	.06	W238501
W238502	18	.31	80	7.0	.59L	.66	.005L	7.5	5.4	.09	W238502
W238503	25	.46	70	8.2	.71L	.79	.005L	9.0	5.9	.13	W238503

Table 3.--Major, minor, and trace element composition of 9 lignite samples from Alaska reported on whole-coal basis,--con

SAMPLE NUMBER	MN PPM	MO-S PPM	N2-S PPM	NO-S PPM	NI-S PPM	P PPM	PB PPM	PR-S PPM	RB PPM	SB PPM	SAMPLE NUMBER
W233091	53	2.7	2.3	4.2	12	1,400	5.2	9.6L	40L	0.21	W233091
W233092	150	1.4	.92	8.5	22	3,500	6.5	7.1L	23L	.10	W233092
W238497	150	2.1	.15	5.2	14	44L	.81	.60	6.0L	.045	W238497
W238498	170	.10L	.61	1.7	13	44L	.29	.32	6.0L	.032	W238498
W238499	1,600	1.9	2.2	6.3L	22	96	.99	3.0	9.0L	.029	W238499
W238500	160	.16L	1.1	3.6	16	1,900	.59	.78	5.0L	.063	W238500
W238501	81	1.2	1.4	8.9	16	4,500	3.3	1.5	6.0L	.10	W238501
W238502	32	2.1	2.2	13	9.2	150	3.4	1.2	9.1	.29	W238502
W238503	38	2.3	1.1	11	15	44L	5.2	1.3	19	.39	W238503

SAMPLE NUMBER	SC PPM	SE PPM	SM PPM	SN-S PPM	SR-S PPM	TA PPM	TB PPM	TH PPM	U PPM	V-S PPM	SAMPLE NUMBER
W233091	3.9	0.35	1.7	2.0	350	0.084	0.22	1.2	0.46	23	W233091
W233092	1.5	.27	1.5	1.6	230L	.046	.15	.77	.25L	9.9	W233092
W238497	.29	.25	.83	.94	22	.070L	.13	.15	.18L	1.1	W238497
W238498	.27	.24	.12	1.5	35	.031	.017	.17	.17L	2.0	W238498
W238499	.22	.90L	.13	15	55	.10L	.060L	.14	.16L	1.5	W238499
W238500	.48	.59	.37	2.8	730	.067	.049	.94	.37	1.4	W238500
W238501	1.8	.30L	1.1	2.0	970	.089	.12	1.0	.48	11	W238501
W238502	4.8	.60L	1.5	2.2	100	.16	.16	1.8	.60	50	W238502
W238503	6.7	.51	2.1	4.2	95	.19	.29	2.7	.62	66	W238503

SAMPLE NUMBER	W PPM	Y-S PPM	YB PPM	ZN PPM	ZR-S PPM
W233091	0.27	9.6	0.66	8.6	23
W233092	.15	6.2	.41	3.8	15
W238497	.11	3.9	.38	6.0	2.6
W238498	.10L	1.2	.11	4.2	5.8
W238499	.20L	.30L	.08	26	12
W238500	.11	2.5	.19	3.9	16
W238501	.30	6.2	.54	2.0	26
W238502	.33	9.0	.72	3.0	34
W238503	.48	14	1.1	3.7	42

Table 40.--Arithmetic means, observed ranges, geometric means, and geometric deviation of concentrations of 42 trace elements in 9 lignite samples from Alaska.

[All data are in parts-per-million and are reported on a whole-coal basis; L means less than value shown.]

Element	Arithmetic mean	Observed range		Geometric mean	Geometric deviation	Geometric mean
		Minimum	Maximum			
AG	0.11	0.07	0.15	0.10	1.4	0.03
AS	1.3	.51	3.1	1.0	1.8	2.6
B	39	14	75	33	1.8	52
BA	1325	260	2592	1095	2.0	326
BE	.67	.16	1.7	.55	1.9	.52
BR	.83	.09	2.6	.50	3.0	.25
CD	.03	.02	.10	.03	1.8	.12
CE	8.5	1.3	16	6.2	2.5	14
CO	6.3	4.0	9.0	6.1	1.3	1.6
CR	8.1	1.1	27	4.5	3.1	3.0
CS	.55	.05	1.7	.24	3.8	.53
CU	7.4	2.3	25	4.8	2.4	9.3
EU	.21	.02	.46	.14	2.9	.24
F	229	30	670	124	3.0	53
GA	2.9	.21	8.2	1.6	3.3	2.6
HF	.39	.06	.79	.29	2.4	.86
LA	5.0	.85	9.0	3.7	2.4	7.4
LI	2.1	.16	5.9	1.1	3.5	3.5
LU	.07	.02	.13	.05	1.7	.09
MN	269	32	1584	120	3.0	34
MO	1.9	1.2	2.7	1.9	1.3	1.3
NB	1.3	.15	2.3	1.1	2.2	1.9
ND	7.0	1.7	15	5.9	1.9	13
NI	16	9.2	22	15	1.3	3.9
PB	2.9	.29	6.5	1.9	2.9	3.8
PR	1.3	.52	3.0	1.0	2.0	9.4
RB	14	9.1	19	13	1.4	27
SB	.14	.03	.39	.10	2.4	.39
SC	2.2	.22	6.7	1.1	3.6	1.7
SE	.37	.25	.59	.35	1.4	.81
SM	1.0	.12	2.1	.70	2.8	.84
SN	3.6	.94	15	2.5	2.1	.97
SR	295	22	972	133	3.7	183
TA	.01	.001	.03	.01	2.9	.02
TB	.14	.02	.29	.11	2.3	.15
TH	.99	.14	2.7	.63	2.9	1.4
U	.51	.37	.62	.50	1.2	.90
V	18	1.1	65	6.9	4.6	13
W	.02	.003	.06	.02	2.8	.10
Y	6.6	1.2	14	5.3	2.1	4.5
YB	.46	.08	1.1	.34	2.4	.41
ZN	7.0	2.0	23	5.0	2.1	10
ZR	20	2.5	42	15	2.3	16

Table 4b.--Arithmetic means, observed ranges, geometric means, and geometric deviation of ash content and contents of 11 major and minor oxides in the laboratory ash 9 lignite samples from Alaska.

[All samples were ashed at 515 C; all data except geometric deviation are in percent; L means less than the value shown.]

Oxide	Arithmetic mean	Observed range		Geometric mean	Geometric deviation	Geometric mean
		Minimum	Maximum			
(Ash)	9.3	2.6	20	7.6	1.9	9.3
SIO2	23	3.0	48	18	2.2	28
AL2O3	19	1.9	29	15	2.3	13
CAO	9.8	3.2	16	8.8	1.7	14
MGO	2.6	1.3	5.0	2.4	1.5	3.8
NA2O	.24	.04	.51	.14	3.1	1.7
K2O	.81	.08	2.4	.45	3.1	.47
FE2O3	23	3.4	74	14	2.8	6.5
TIO2	.60	.05	.99	.47	2.4	.75
P2O5	6.1	.11	13	2.2	6.6	.64
SO3	20	4.5	44	13	2.1	14

ACKNOWLEDGMENTS

The authors wish to thank the following people for their assistance and contribution to this report: Charles L. Oman and Linda J. Bragg (U.S. Geological Survey) for their continued support in sample submission, processing, status reports, and computer data generation; and the analytical chemistry staff of the U.S. Geological Survey for performing the analyses.

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