Chemical analyses of coal from the Healy, Kenai, Seldovia, and Utukok River 1:250,000 quadrangles, Alaska

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INTRODUCTION

As part of a continuing program by the U.S. Geological Survey to collect and to chemically analyze representative samples of coal in the United States, a total of 118 coal samples were collected in the State of Alaska. These samples were collected during a five-year period by the U.S. Geological Survey and Alaskan Division of Geological and Geophysical Surveys. These samples consist of 20 samples (15 channel, 5 core) from the Healy 1:250,000 quadrangle; 10 samples (10 channel) from the Kenai 1:250,000 quadrangle; 34 samples (34 channel) from the Seldovia 1:250,000 quadrangle; and 54 samples (31 channel, 18 auger, 5 cuttings) from the Utukok River 1:250,000 quadrangle. U.S. Geological Survey sample numbers, locations, thickness, and sample type for all 118 samples are listed in table 1. Locations of sampled quadrangles are shown in figure 1.

This report briefly summarizes all available chemical data from these Alaskan coals and statistically compares them with other United States coal of comparable age and rank. For this purpose, data summaries of coal from the Powder River region are included for comparison to the Healy, Kenai, and Seldovia region samples, and data summaries of Rocky Mountain Province coal are included for the Utukok River samples.

GEOLOGIC OCCURRENCE

Healy Quadrangle

Samples collected in the Healy 1:250,000 quadrangle are from the Nenana coal field. Upper Oligocene to Late Upper Pliocene coal-bearing rocks have been faulted and folded into a series of disconnected basins that extend 80 miles along the northern flank of the Alaska Range. Dips are low to moderate. Coal beds, ranging in thickness from a few inches to 60 feet, are found in four formations (figure 2). The greatest number of beds and thickest coal beds are in the Healy Creek and Suntrana Formations.

Table 1.--U.S. Geological Survey sample numbers, locations, thickness, and sample type for 118 coal samples from the Healy, Kenai, Seldovia, and Utukok River quadrangles, Alaska--Continued

USGS Sample Number	Latitude	Longitude	Thickness (feet)	Sample type
		Utukok River Quadrangle		
D203122	69°15'45"	159°08'15"	12.0	Cuttings
D203123	69°41'35"	161°42'36"	25.0	Do.
D203124	69°31'15"	161°27'45"	7.0	Do.
D203125	69°31'26"	160°14'00"	15.0	Do.
D203126	69°31'26"	160°14'00"	20.0	Do.
D213965	69°21'10"	161°24'45"	11.8	Auger
D213966	69°22'05"	161°22'00"	4.3	Do.
D213967	69°24'00"	161°16'30"	7.5	Do.
D213968	69°23'10"	161°15'00"	8.9	Do.
D213969	69°22'05"	161°15'00"	11.2	Do.
D213970	69°21'10"	161°15'00"	5.6	Do.
D213971	69°23'10"	161°03'00"	7.5	Do.
D213972	69°22'50"	161°05'20"	6.9	Do.
D213973	69°23'10"	161°05'20"	6.9	Do.
D213974	69°24'00"	161°01'45"	7.2	Do.
D213975	69°20'25"	160°34'20"	7.5	Do.
D213976	69°20'25"	160°28'30"	11.2	Do.
D213977	69°20'25"	160°28'30"	12.8	Do.
D213978	69°21'10"	160°24'10"	7.2	Do.
D213979	69°23'10"	160°31'30"	13	Do.
D213980	69°27'30"	160°42'00"	5.6	Do.
D213981	69°26'45"	160°45'00"	6.6	Do.
D213982	69°26'45"	160°47'20"	4.3	Do.
D213944	69°07'30"	161°24'40"	2.0	Channel
D213945	69°08'25"	161°24'40"	1.6	Do.
D213946	69°06'40"	161°32'00"	8.9	Do.
D213947	69°05'45"	161°29'45"	11.5	Do.
D213948	69°05'45"	161°29'45"	11.5	Do.
D213949	69°05'45"	161°20'00"	7.5	Channel
D213950	69°06'45"	161°29'45"	6.9	Do.
D213951	69°04'00"	161°27'00"	.98	Do.
D213952	69°04'00"	161°27'00"	3.6	Do.
D213953	69°24'45"	161°11'45"	8.2	Do.
D213954	69°24'45"	161°06'45"	4.9	Do.
D213955	69°25'40"	160°13'00"	2.6	Do.

Table 1.--U.S. Geological Survey sample numbers, locations, thickness, and sample type for 118 coal samples from the Healy, Kenai, Seldovia, and Utukok River quadrangles, Alaska--Continued

USGS Sample Number	Latitude	Longitude	Thickness (feet)	Sample type
		Seldovia Quadrangle		
D169256	59°45'	151°00'	5.5	Channel
D169257	59°45'	151°00'	3.2	Do.
D169258	59°30'	151°30'	2.0	Do.
D169259	59°30'	151°30'	5.9	Do.
D169260	59°30'	151°30'	2.4	Do.
D169261	59°30'	151°30'	2.7	Do.
D169262	59°30'	151°30'	3.6	Do.
		Utukok River Quadrangle		
D184598	69°22'56"	161°23'22"	3.2	Channel
D184599	69°22'10"	161°23'20"	2.0	Do.
D184600	69°23'08"	161°16'06"	4.8	Do.
D184601	69°26'48"	160°45'12"	5.5	Do.
D184602	69°22'00"	161°14'50"	5.2	Do.
D184603	69°21'40"	161°14'10"	4.2	Do.
D184604	69°21'42"	161°27'25"	3.3	Do.
D184605	69°21'42"	161°27'25"	6.2	Do.
D184606	69°21'42"	161°27'25"	3.9	Do.
D184607	69°20'24"	160°30'40"	5.4	Do.
D184608	69°20'24"	160°30'40"	4.2	Do.
D184609	69°20'44"	160°28'08"	5.4	Do.
D184610	69°20'40"	160°25'55"	4.1	Do.
D184611	69°31'43"	161°20'26"	3.0	Do.
D184612	69°21'54"	160°21'45"	5.3	Do.
D184613	69°27'58"	161°22'28"	6.3	Do.
D184614	69°28'32"	161°22'20"	1.3	Do.
D184615	69°27'08"	161°22'20"	1.5	Do.
D184616	69°26'17"	161°20'46"	3.1	Do.

Table 1.--U.S. Geological Survey sample numbers, locations, thickness, and sample type for 118 coal samples from the Healy, Kenai, Seldovia, and Utukok River quadrangles, Alaska--Continued

USGS Sample Number	Latitude	Longitude	Thickness (feet)	Sample type
		Seldovia Quadrangle		
D169228	59°45'	151°00'	1.4	Channel
D169229	59°45'	151°00'	1.4	Do.
D169230	59°45'	151°00'	2.4	Do.
D169231	59°45'	151°00'	1.8	Do.
D169232	59°45'	151°00'	2.6	Do.
D169233	59°45'	151°00'	3.7	Do.
D169234	59°30'	151°15'	2.8	Do.
D169236	59°30'	151°15'	4.9	Do.
D169237	59°30'	151°15'	4.9	Do.
D169238	59°30'	151°15'	5.0	Do.
D169239	59°30'	151°15'	5.0	Do.
D169240	59°30'	151°15'	1.0	Do.
D169241	59°45'	151°15'	1.3	Do.
D169242	59°45'	151°15'	.9	Do.
D169243	59°45'	151°15'	1.3	Do.
D169244	59°45'	151°15'	1.6	Do.
D169245	59°45'	151°15'	3.4	Do.
D169246	59°45'	151°15'	.5	Do.
D169247	59°45'	151°15'	1.6	Do.
D169248	59°45'	151°15'	2.1	Do.
D169249	59°45'	151°15'	1.6	Do.
D169250	59°45'	151°15'	5.2	Do.
D169251	59°45'	151°15'	1.3	Do.
D169252	59°45'	151°15'	3.1	Do.
D169253	59°45'	151°15'	2.8	Do.
D169254	59°45'	151°15'	5.5	Do.
D169255	59°45'	151°15'	3.5	Do.

Table 1.--U.S. Geological Survey sample numbers, locations, thickness, and sample type for 118 coal samples from the Healy, Kenai, Seldovia, and Utukok River quadrangles, Alaska

[All latitudes (north) and longitudes (west) are given in degrees, minutes, and seconds, except the Seldovia quadrangle for which only degrees and minutes are given.]

USGS Sample Number	Latitude	Longitude	Thickness (feet)	Sample type
		Healy Quadrangle		
D172389	63°55'09"	148°40'00"	5.0	Channel
D172390	63°55'09"	148°40'00"	5.0	Do.
D172391	63°55'09"	148°40'00"	5.6	Do.
D172392	63°55'09"	148°40'00"	3.0	Do.
D172393	63°55'09"	148°40'00"	5.0	Do.
D172394	63°55'09"	148°40'00"	5.0	Do.
D172395	63°55'09"	148°40'00"	5.0	Do.
D172396	63°55'09"	148°40'00"	5.0	Do.
D175053	63°58'12"	148°45'00"	5.0	Do.
D175054	63°58'12"	148°45'00"	5.0	Do.
D175055	63°58'12"	148°45'00"	5.0	Do.
D175056	63°58'12"	148°45'00"	5.0	Do.
D175057	63°58'12"	148°45'00"	7.1	Do.
D186043	63°54'10"	148°56'16"	10.5	Core
D186044	63°54'10"	148°56'16"	10.0	Do.
D186045	63°54'10"	148°56'16"	6.0	Do.
D186046	63°54'10"	148°56'16"	9.3	Do.
D186047	63°54'10"	148°56'16"	9.5	Do.
D186048	63°58'36"	147°16'22"	7.0	Channel
D186049	63°58'36"	147°16'22"	7.0	Do.
		Kenai Quadrangle		
D178628	60°01'53"	151°40'15"	4.8	Channel
D178629	60°03'39"	151°39'14"	4.0	Do.
D178630	60°03'39"	151°39'14"	5.0	Do.
D178773	60°00'24"	151°37'22"	6.5	Channel
D178774	60°04'17"	151°38'28"	4.4	Do.
D178775	60°04'03"	151°38'46"	4.5	Do.
D178776	60°04'03"	151°38'46"	7.2	Do.
D178777	60°12'11"	151°26'03"	4.3	Do.
D178778	60°12'29"	151°26'34"	4.2	Do.
D178779	60°12'29"	151°26'34"	2.0	Do.

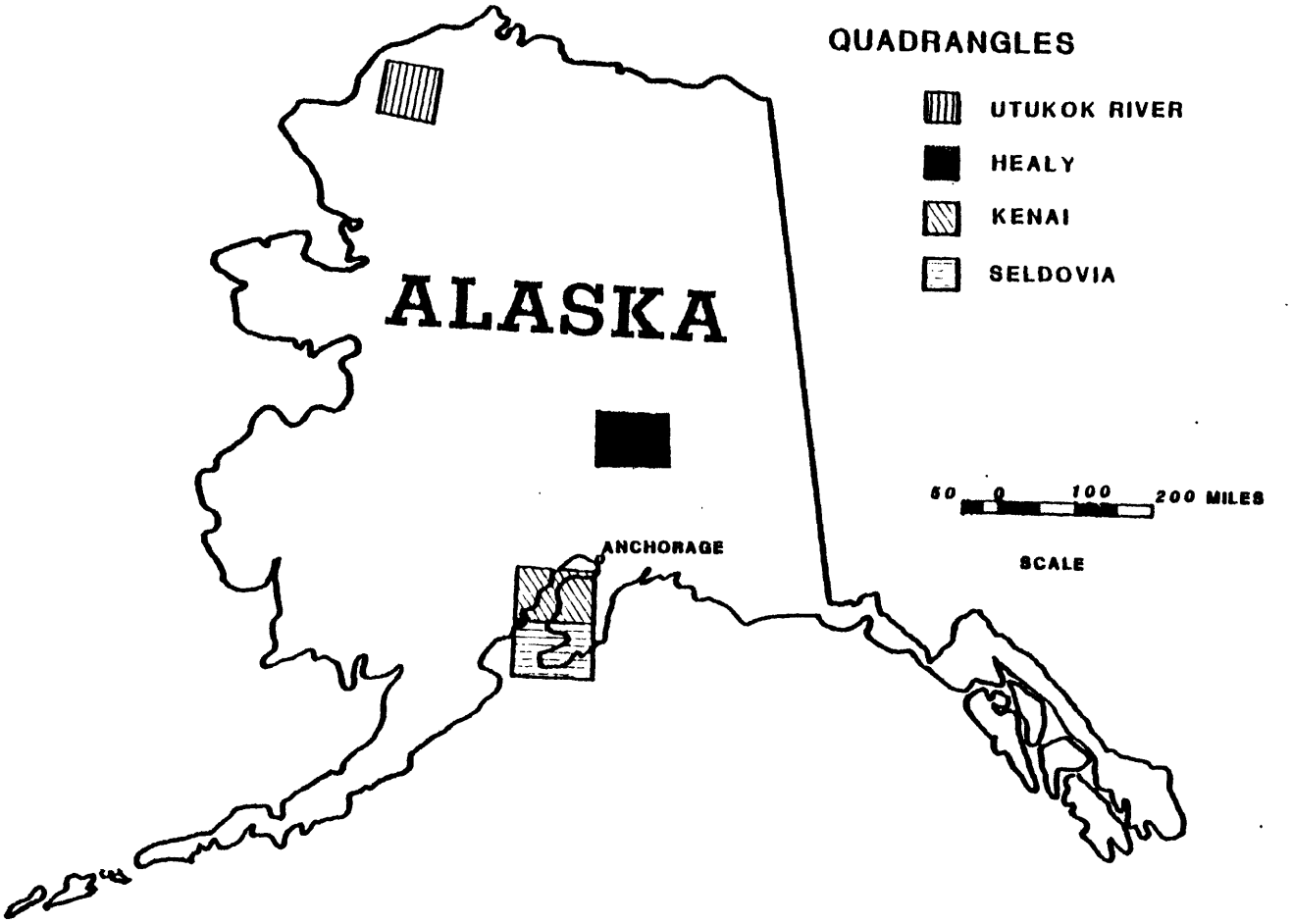


Figure 1.--Index map showing the location of the Utukok River, Healy, Kenai, and Seldovia quadrangles, Alaska, in which coal samples were collected.

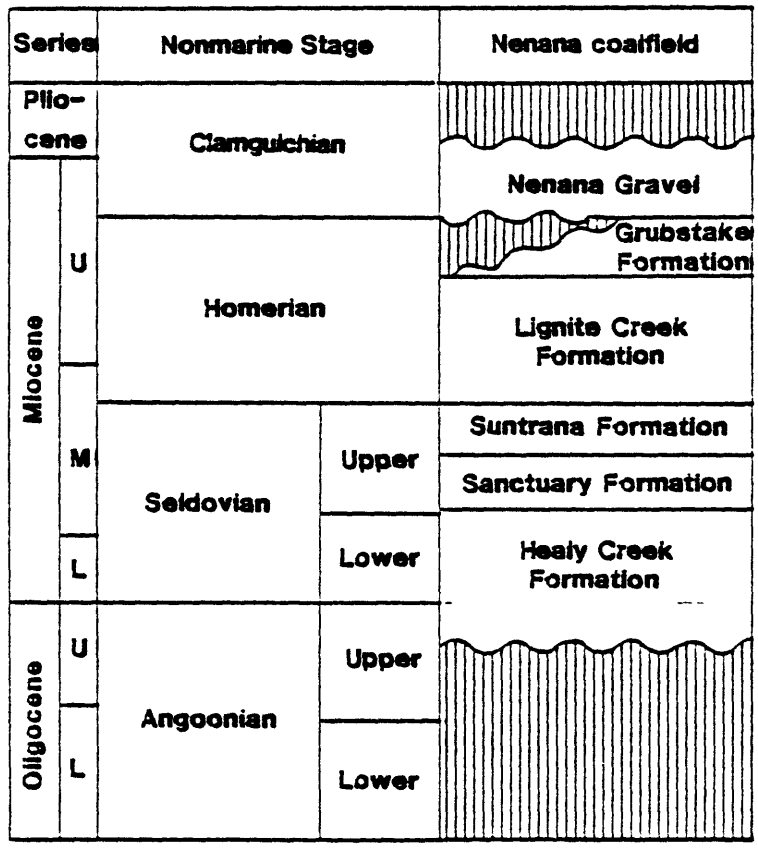


Figure 2.--Stratigraphic nomenclature of the coal-bearing rocks of the Nenana coalfield, Alaska, after Wolfe and Tanai, (1980, p. 9).

Kenai and Seldovia Quadrangles

The Kenai and Seldovia 1:250,000 quadrangles lie within the Kenai coal field (Barnes, 1967). Tertiary coal beds of the Cook Inlet Region are included in the Oligocene to Pliocene Kenai Group (figure 3). The coal-bearing rocks are within a broad structural basin modified locally by gentle folds. The deepest part of the basin is in Cook Inlet. Dips are generally less than 5 degrees. Most high-angle faults have displacements of less than 80 feet. The most numerous and thickest (as much as 7 feet) coal beds in the Kenai-Seldovia area are in the Tyonek Formation.

Utukok River Quadrangle

The Utukok River 1:250,000 quadrangle lies within the Kokolik-Utukok Rivers district of the northern Alaska coal field (Barnes, 1967). The Cretaceous coal-bearing Corwin Formation (figure 4) has been folded into many east-west trending synclines and anticlines the limbs of which dip 5-20 degrees. Many coal beds, ranging from a few inches to more than 12 feet, are present in the Corwin Formation. Exposures are limited however, and are restricted to major drainages.

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 52 samples from the Healy, Kenai, Seldovia, and Utukok River quadrangles, Alaska, are listed in tables 2, 6, 10 and 14. All of these analyses were done by the U.S. Department of Energy, Pittsburgh, Pa. Analyses for ash content and 35 major and minor oxides and trace elements in the laboratory ash (tables 3, 7, 11 and 15) and analyses of seven trace elements in whole coal (tables 4, 8, 12, 16) for all 118 samples were done by the U.S. Geological Survey, Denver, Co. Analytical procedures used by the U.S.

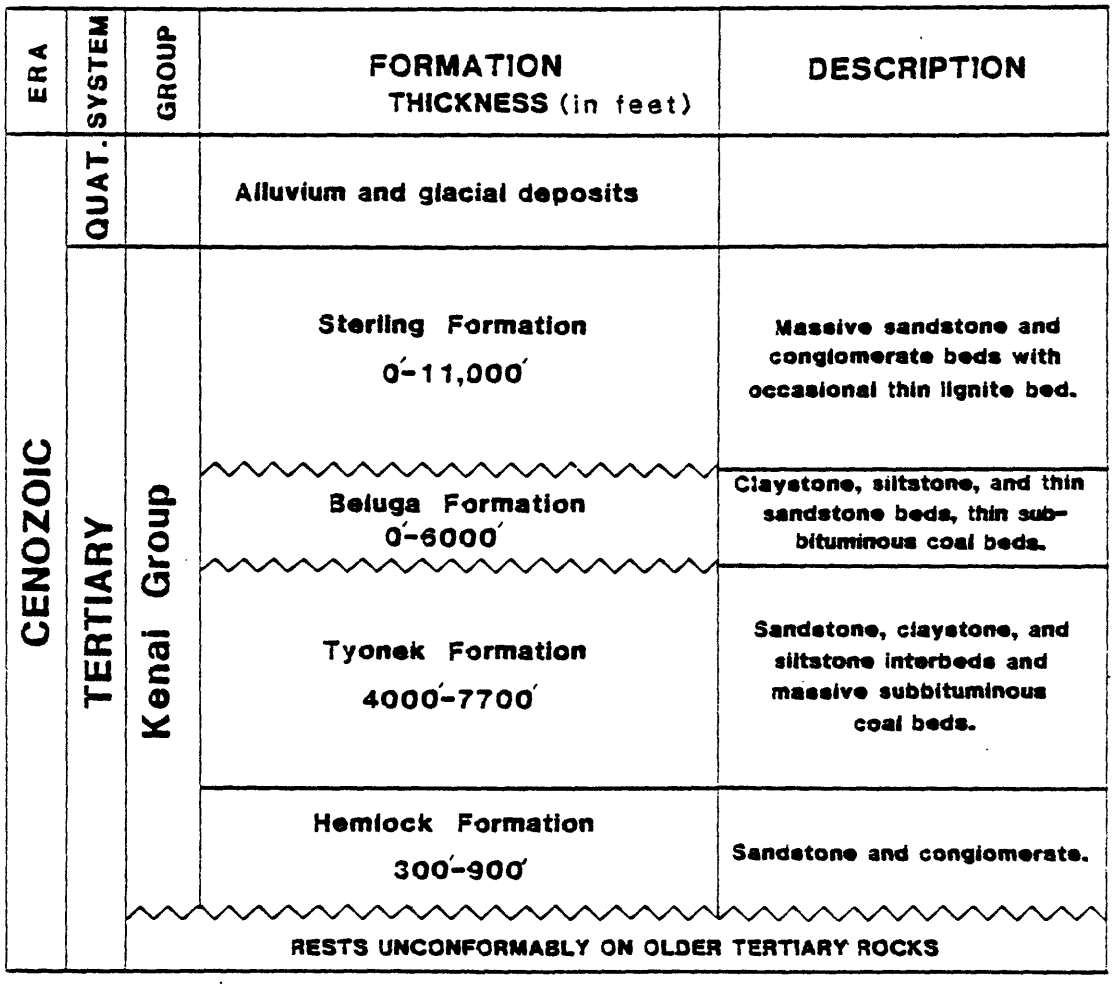


Figure 3.--Stratigraphic nomenclature of Tertiary Kenai Group, Alaska, after Calderwood and Fackler, (1972, p. 741).

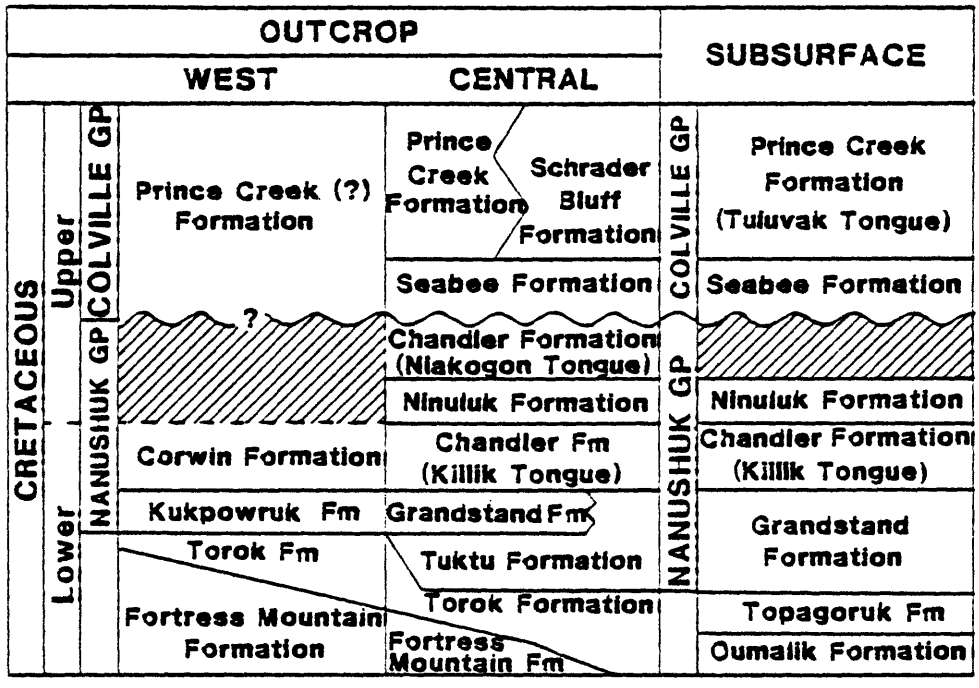


Figure 4.--Stratigraphic nomenclature of the Colville and Nanushuk Groups, Alaska, from Ahlbrandt and others, (1979, p. 14).

Geological Survey are described in Swanson and Huffman (1976). (See fig. 5 for flow chart showing sequence of sample preparation and analysis).

Tables 5, 9, 13, and 17 contains the data listed in tables 3, 7, 8 and 9 respectively converted to a whole coal basis plus the whole-coal analyses listed in tables 4, 8, 12 and 16. Twenty-two additional elements not listed in tables 3, 4, 5, 7, 8, 9, 11, 12, 13, 15, 16, and 17 were looked for but not found in amounts greater than their lower limits of detection (table 18). Unweighted statistical summaries of the analytical data for all 118 Alaskan coal samples in tables 2 through 17 are listed in tables 19 through 30.

Arsenic contents of samples summarized in this report have been determined by three different analytical methods: Samples D169228-D169234, D169236-D169262, D175053-D175057, and D172389-D172396 were analyzed spectrophotometrically (lower detection limit 1.0 ppm); samples D178773-D178779 and D178628-D178630 were analyzed by the graphite furnace-atomic absorption method (lower detection limit 0.5 ppm); the other 61 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 D169228-D169234, D169236-D169262, D175053-D175057, D172389-D172396, D178774-D178779, and D178628-D178630 were analyzed by delayed neutron-activation analysis (lower detection limit 3.0 ppm); all other samples were analyzed by instrumental neutron-activation analysis (lower detection limit 0.1 ppm).

P_2O_5 contents of the samples were determined by X-ray fluorescence spectroscopy. However, due to changes in technique, the lower detection limit for samples D213965-D213982 and D213944-D213955 is 0.01 percent in whole coal; for samples D169228-D169234, D169236-D169262, and D178773-D178779 is 0.1 percent in coal ash; and for the 47 remaining samples, is 1.0 percent in coal ash.

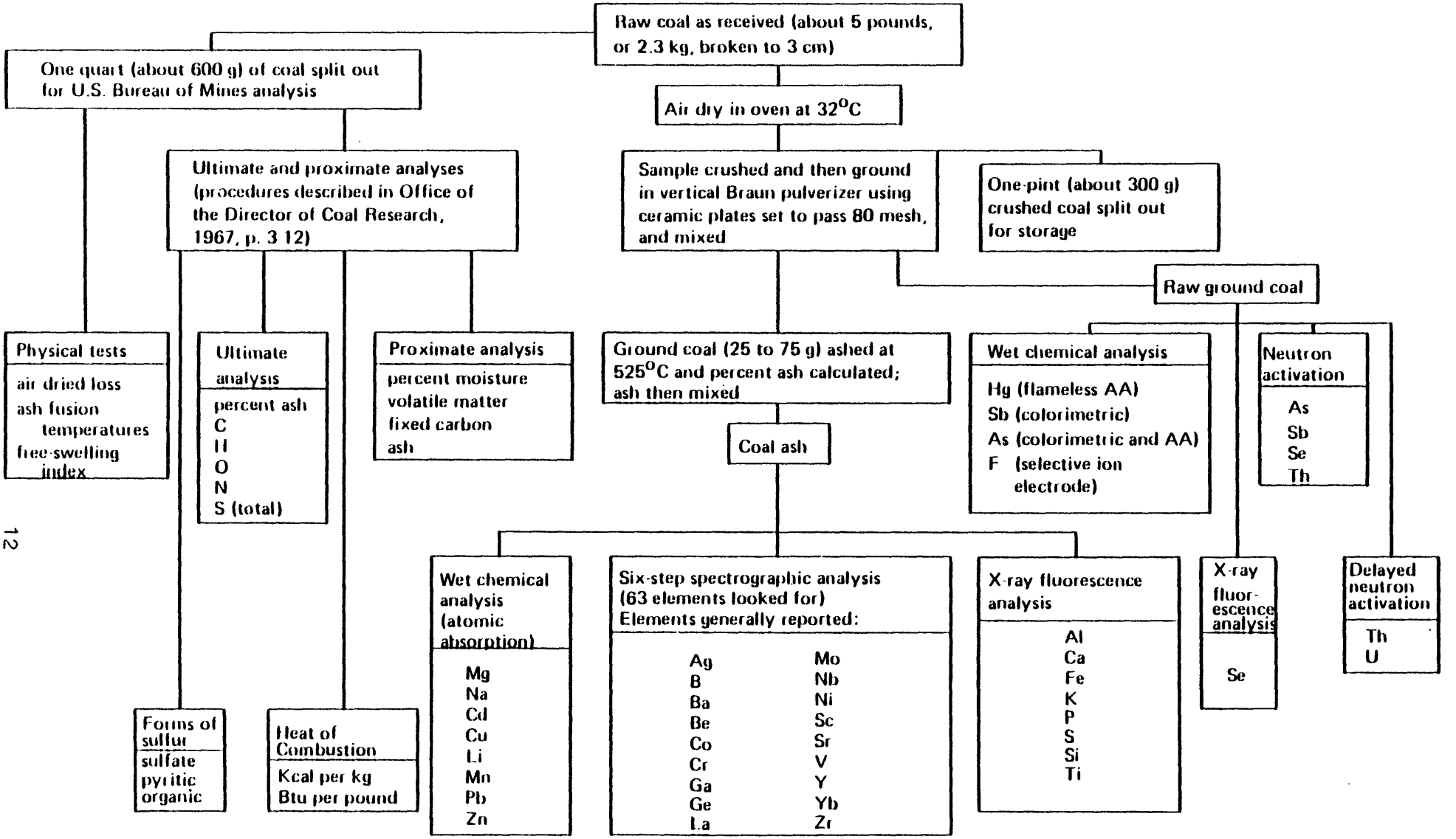


Figure 5.--Flow chart showing sequence of sample preparation and chemical analysis (modified from Swanson and Huffman, 1976, fig. 1).

To be consistent with the precision of the semiquantitative emission spectrographic technique, arithmetic and geometric means of elements determined by this method 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.

Channel samples analyzed for the present study are considered to be of the same quality as outcrop samples. Preliminary investigations on Wyoming coals (Hatch and Affolter, 1981) indicate significant chemical differences between outcrop and core samples. Outcrop samples have significantly higher moisture, volatile matter, oxygen, and nitrogen contents, and significantly lower ash, hydrogen, and sulfur contents and a significantly lower heat of combustion. At the present time, we have insufficient data to accurately determine if the same chemical differences apply to our samples of Alaska coal.

EXPLANATION OF STATISTICAL TERMS USED IN SUMMARY TABLES

In this report, 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 $GM \cdot GD^2$ (Connor 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 estimates of the arithmetic means listed in the summary tables are Sichel's 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 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.

DISCUSSION

The apparent ranks of all 52 coal samples from the Healy, Kenai, Seldovia, and Utukok River quadrangles, Alaska, were calculated using the formulas in ASTM designation D-388-77 (American Society for Testing and Materials, 1978). When calculated to a moist-mineral-matter free basis, the ranges in apparent rank of coal from each quadrangle are as follows (see figure 6):

--Healy quadrangle (12 samples)

Lignite A to subbituminous B coal

--Kenai quadrangle (10 samples)

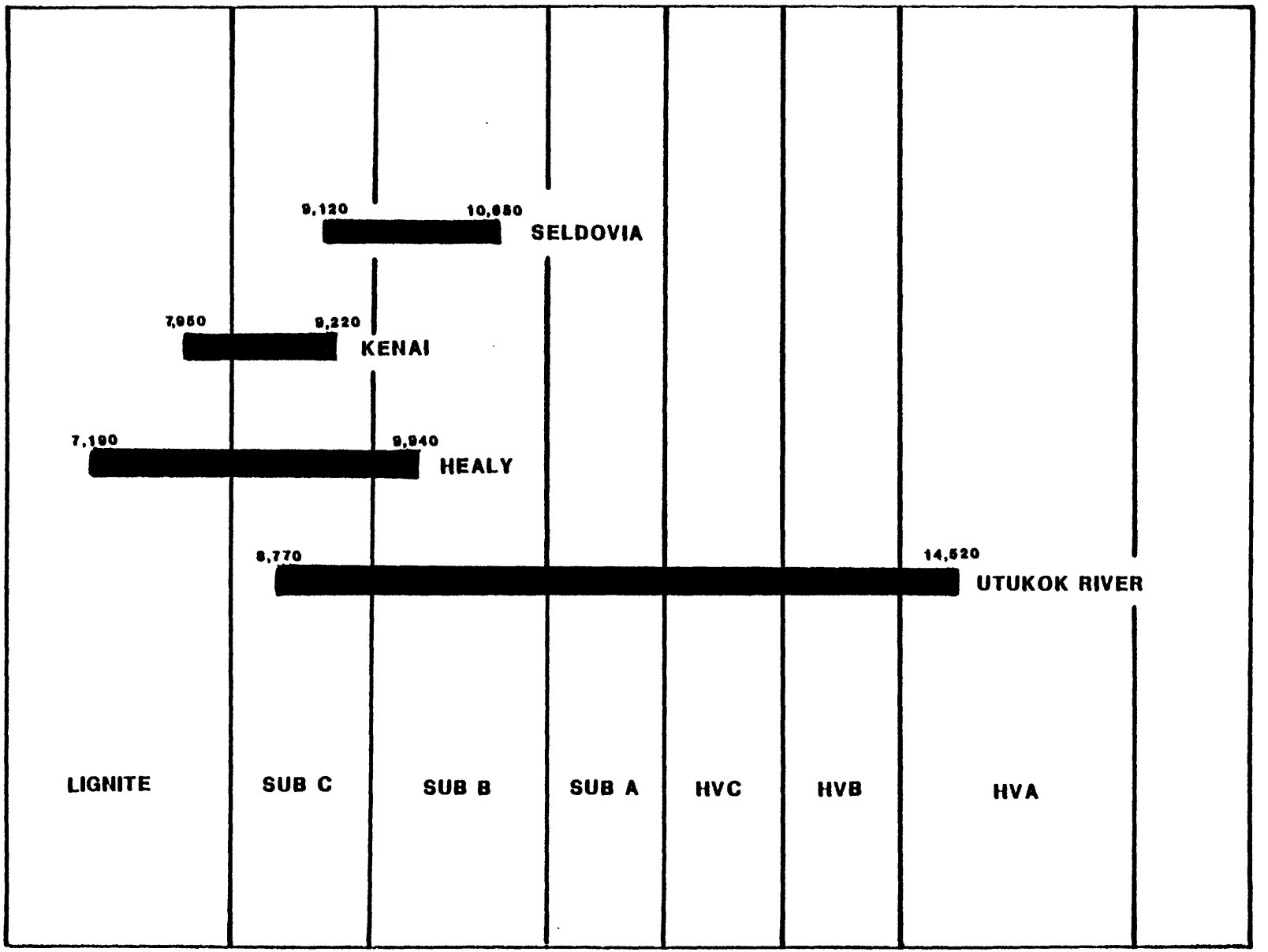


Figure 6.--Range of apparent rank determinations for coal samples from the Seldovia, Kenai, Healy, and Utukok River quadrangles, Alaska.

Lignite A to subbituminous C coal

--Seldovia quadrangle (6 samples)

Subbituminous C to subbituminous B coal

--Utukok quadrangle (24 samples)

Subbituminous C to high-volatile A bituminous coal

A statistical comparison (student's t-test, 95-percent confidence level) of the geometric mean contents of the U.S. Department of Energy's data for 12 coal samples from the Healy quadrangle with 33 coal samples from the Powder River region (Swanson and others, 1976) shows that coal from the Healy quadrangle is significantly higher in volatile matter and oxygen, is significantly lower in fixed carbon, carbon, nitrogen, total sulfur, and sulfate, pyritic and organic sulfur contents, and has a significantly lower heat of combustion. The moisture, ash, and hydrogen contents are not significantly different. When compared at the 99-percent confidence level, the carbon and oxygen contents are not significantly different.

A statistical comparison of the geometric mean contents of the U.S. Department of Energy's data for 10 coal samples from the Kenai quadrangle with 33 coal samples from the Powder River region shows that coal from the Kenai quadrangle is significantly higher in volatile matter and ash, significantly lower in fixed carbon, carbon, total sulfur and pyritic sulfur contents, and has a significantly lower heat of combustion. The moisture, hydrogen, nitrogen, oxygen, and organic sulfur contents are not significantly different.

A statistical comparison of the geometric mean contents of the U.S. Department of Energy's data for 6 coal samples from the Seldovia quadrangle with 33 coal samples from the Powder River region shows that coal from the Seldovia quadrangle is significantly higher in volatile matter and ash, and is significantly lower in moisture, fixed carbon, total sulfur, sulfate, and

pyritic sulfur contents. The hydrogen, carbon, nitrogen, and oxygen contents and the heat of combustion are not significantly different. When compared at the 99-percent confidence level, the contents of ash and sulfate sulfur are not significantly different.

A statistical comparison of the geometric mean contents of the U.S. Department of Energy's data for 24 coal samples from the Utukok River quadrangle with 86 coal samples from the Rocky Mountain province (Swanson and others, 1976) shows that coal from the Utukok River quadrangle is significantly higher in fixed carbon and nitrogen, and is significantly lower in volatile matter, hydrogen, and total sulfur contents. The moisture, ash, carbon, and oxygen content and heat of combustion 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 20 coal samples from the Healy quadrangle with 410 Powder River region coal samples (Hatch and Swanson, 1977) shows that coal from the Healy quadrangle contains significantly higher ash, and that this ash is significantly higher in K_2O and TiO_2 contents and significantly lower in Na_2O, Fe_2O_3 and SO_3 contents. Contents of SiO_2, Al_2O_3, CaO and MgO are not significantly different. When compared at the 99-percent confidence level, the contents of Fe_2O_3 are not significantly different.

A statistical comparison of the geometric mean contents of nine major and minor oxides in the ash of 10 coal samples from the Kenai quadrangle with 410 Powder River region coal samples shows that coal from the Kenai quadrangle contains significantly higher ash, and that this ash is significantly higher in SiO_2, MgO, Na_2O, and K_2O contents, and is significantly lower in CaO and SO_3 contents. Contents of Al_2O_3, Fe_2O_3, and TiO_2 are not significantly

different. When compared at the 99-percent confidence level the contents of SiO_2, MgO, and Na_2O are not significantly different.

A statistical comparison of the geometric mean contents of nine major and minor oxides in the ash of 34 coal samples from the Seldovia quadrangle with 410 Powder River region coal samples shows that coal from the Seldovia quadrangle contains significantly higher ash, and that this ash is significantly higher in SiO_2, Al_2O_3, K_2O, and TiO_2 contents and significantly lower in CaO, MgO, and SO_3 contents. Contents of Na_2O and Fe_2O_3 are not significantly different. When compared at the 99-percent confidence level, the contents of CaO and TiO_2 are not significantly different.

A statistical comparison of the geometric mean contents of nine major and minor oxides in the ash of 54 coal samples from the Utukok River quadrangle with 295 Rocky Mountain province coal samples (Hatch and Swanson, 1977) shows that coal from the Utukok River quadrangle contains significantly lower ash, and that this ash is significantly higher in Al_2O_3, MgO, Na_2O, K_2O, and TiO_2 contents and significantly lower in SiO_2 content. The contents of CaO, Fe_2O_3, and SO_3 are not significantly different.

A statistical comparison of the geometric mean contents of 35 elements in 20 coal samples from the Healy quadrangle with 410 Powder River region coal samples (Hatch & Swanson, 1977) shows that the coal from the Healy quadrangle is significantly higher in contents of Si, Al, Ca, K, Ti, Ba, Co, Cr, Cu, F, Ga, Ni, Sb, Sc, U, V, Y and Yb, and is significantly lower in contents of Na, B, Be and Sr. The contents of Mg, Fe, As, Hg, Li, Mn, Mo, Nb, Pb, Se, Th, Zn and Zr are not significantly different. When compared at the 99-percent confidence level, the contents of Si, Ca, and Sr are not significantly different.

A statistical comparison of the geometric mean contents of 35 elements in 10 coal samples from the Kenai quadrangle with 410 Powder River region coal samples shows that coal from the Kenai quadrangle is significantly higher in contents of Si, Al, Mg, Na, K, Ti, Ba, Co, Cr, Cu, Ga, Mn, Mo, Nb, Ni, Sc, V, Y, and Yb, and is significantly lower in contents of Ca, B, and Se. The contents of Fe, As, Be, F, Hg, Li, Sb, Sr, U, Zn, and Zr are not significantly different.

A statistical comparison of the geometric mean contents of 35 elements in 34 coal samples from the Seldovia quadrangle with 410 Powder River region coal samples shows that coal from the Seldovia quadrangle is significantly higher in contents of Si, Al, Ca, Na, K, Fe, Ti, As, Ba, Co, Cr, Cu, F, Ga, Mn, Ni, Sb, Sc, Sr, V, Y, and Yb, and is significantly lower in contents of Mg, B, Be, Pb, Se, Th, and Zr. The contents of Hg, Li, Mo, Nb, U, and Zr are not significantly different. When compared at the 99-percent confidence level, the contents of Ca, Na, Fe, and Sr are not significantly different.

A statistical comparison of the geometric mean contents of 35 elements in 54 coal samples from the Utukok River quadrangle with 295 Rocky Mountain province coal samples (Hatch & Swanson, 1977) shows that coal from the Utukok River quadrangle is significantly higher in contents of Mg, Na, K, Ba, Co, Ni, Sc, and Sr, and is significantly lower in contents of Si, Al, B, Be, Cr, Cu, F, Mo, Pb, Sb, Se, Th, and V. The contents of Ca, Fe, Ti, As, Ga, Hg, Li, Mn, Nb, U, Y, Yb, Zn, and Zr are not significantly different. When compared at the 99-percent confidence level, the content of Na is not significantly different.

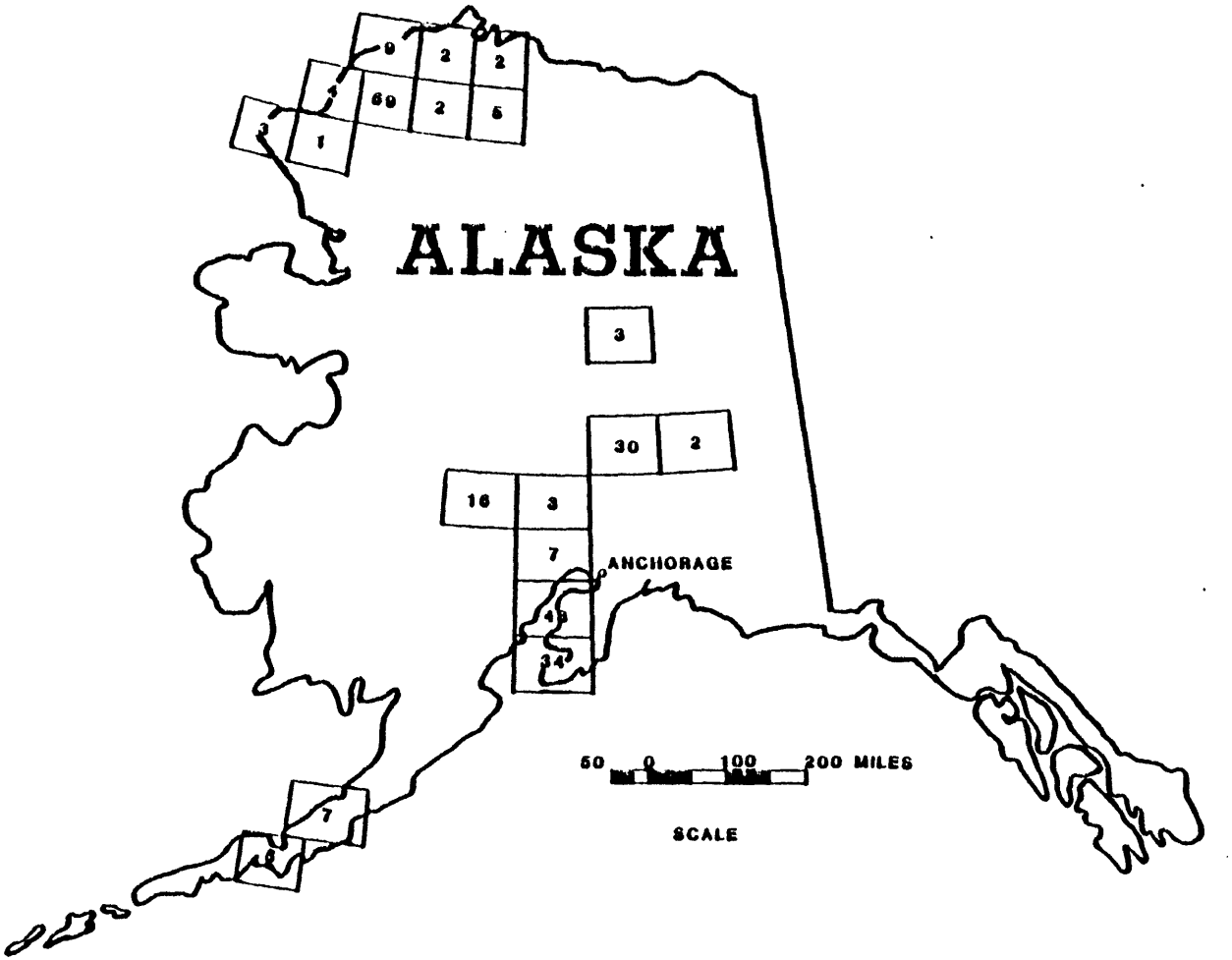
Differences in the oxide composition of coal ashes and the elemental contents of coal result from differences in the total and relative amounts of the various inorganic minerals, the elemental composition of these minerals,

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 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 Healy, Kenai, Seldovia and Utukok River quadrangles, Alaska.

Compared to other United States coals (Swanson and others, 1976; Hatch and Swanson, 1977), coal from the Healy, Kenai, Seldovia, and Utukok River quadrangles, Alaska, are characterized by relatively low sulfur and by lower heat of combustion. The contents of elements of environmental concern, such as As, Be, Hg, Mo, Sb, and Se, are lower in Alaskan coals when compared with most other U.S. coals.

Quality information about Alaskan coal is dependent on an active program of geological mapping and exploratory drilling in coal-field areas. However, during the past 5 years only 19 quadrangles in Alaska have been sampled for coal (fig. 7). Most samples in these areas were of insufficient quantity and quality to be included in this report. Only the Healy, Kenai, Seldovia and Utukok River quadrangles had enough samples of sufficient quality to be adequately summarized.

There is presently no coal exploratory drilling being done by the U.S. Geological Survey, and only two geologists are currently working on evaluating coal resources in Alaska. We suggest that more intensive research be done on coals in Alaska because they may constitute one of the largest resources of coal in the United States.



QUADRANGLES SAMPLED FOR CHEMICAL ANALYSIS

Figure 7.--Index map showing the location of nineteen quadrangles in Alaska that have been sampled for chemical analysis. Numbers inside quadrangles indicate number of samples.

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REFERENCES CITED

Ahlbrandt, T. S., Huffman, A. C., Jr., Fox, J. E., and Pasternach, I., 1979, Depositional framework and reservoir-quality studies of selected Nanushuk Group outcrops, North Slope, Alaska, in Ahlbrandt, T. S., ed. Preliminary geologic, petrologic, and paleontologic results of the study of Nanushuk Group rocks, North Slope, Alaska: U.S. Geological Survey Circular 794, 163 p.

American Society for Testing and Materials, 1978, Standard specifications for classification of coals by rank (ASTM designation D-388-77): 1978 Annual book of ASTM standards, pt. 26, p. 220-224.

Barnes, F. F., 1967, Coal Resources of Alaska: U.S. Geological Survey Bulletin 1242-B, 36 p.

Calderwood, K. W., and Fackler, W. C., 1972, Proposed stratigraphic nomenclature for Kenai Group, Cook Inlet Basin, Alaska: American Association of Petroleum Geologists Bulletin, v. 56, no. 4, p. 739-754.

Cohen, A. C., 1959, Simplified estimators for the normal distribution when samples are singly censored or truncated: Technometrics, v. 1, no. 3, p. 217-237.

Connor, J. J., Keith, J. R., and Anderson, B. M., 1976, Trace-metal variation in soils and sagebrush in the Powder River basin, Wyoming and Montana: U.S. Geological Survey Journal of Research, v. 4, no. 1, p. 49-59.

Hatch, J. R. and Affolter, R. H., 1981, Weathering induced chemical changes in coal from the Paleocene age Fort Union Formation, Red Rim Area, Sweetwater and Carbon Counties, Wyoming: American Association of Petroleum Geologists Bulletin, v. 65, no. 5, p. 936.

Hatch, J. R., and Swanson, V. E., 1977, Trace elements in Rocky Mountain coals, in Murray, D. K., ed., Geology of Rocky Mountain coal--A Symposium: Colorado Geological Survey Resources Series 1, p. 143-165.

Miesch, A. T., 1967, Methods of computation for estimating geochemical abundances: U.S. Geological Survey Professional Paper 574-B, 15 p.

Swanson, V. E., and Huffman, C., 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.

Swanson, V. E., Medlin, J. H., Hatch, J. R., Coleman, S. L., Wood, G. H., Jr., Woodruff, S. D., and Hildebrand, R. T., 1976, Collection, chemical analysis, and evaluations of coal samples in 1975: U.S. Geological Survey Open-File Report 76-468, 503 p.

Wolfe, J. A., and Tanai, T., 1980, The Miocene Seldovia Point flora from the Kenai Group, Alaska: U.S. Geological Survey Professional Paper 1105, 78 p.

Table 2.--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 Healy quadrangle, Alaska

[All analyses except heat of combustion, free-swelling index, and ash-fusion temperatures are 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); °F = (°C x 1.8) + 32; L, less than the value shown, B, not determined. Sample D175053* is a composite of D175053, D175054, D175055, D175056, and D175057; D186043* is a composite of D186043 and D186044; D186045* is a composite of D186045, D186046, and D186047; D186048* is a composite of D186048 and D186049]

Sample number	Proximate Analysis				Ultimate Analysis					Heat of Combustion	
	Moisture	Volatile matter	Fixed carbon	Ash	Hydrogen	Carbon	Nitrogen	Oxygen	Sulfur	Kcal/kg	Btu/lb
D172389	24.0	35.9	33.4	6.7	6.4	49.1	0.8	36.8	0.2	4,700	8,460
	---	47.2	43.9	8.8	4.9	64.6	1.1	20.4	.3	6,180	11,130
	---	51.8	48.2	---	5.4	70.9	1.2	22.3	.3	6,780	12,210
D172390	22.6	35.3	31.9	10.2	6.1	47.7	.8	35.0	.2	4,580	8,240
	---	45.6	41.2	13.2	4.6	61.6	1.0	19.3	.3	5,910	10,650
	---	52.5	47.5	---	5.3	71.0	1.2	22.2	.3	6,810	12,260
D172391	23.5	36.4	33.2	6.9	6.4	50.4	.8	35.3	.2	4,870	8,760
	---	47.6	43.4	9.0	5.0	65.9	1.0	18.8	.3	6,360	11,450
	---	52.3	47.7	---	5.4	72.4	1.1	20.7	.3	6,990	12,590
D172392	14.8	27.3	23.4	34.5	4.6	35.6	.6	24.5	.2	3,410	6,130
	---	32.0	27.5	40.5	3.5	41.8	.7	13.3	.2	4,000	7,190
	---	53.8	46.2	---	5.8	70.2	1.2	22.4	.4	6,720	12,090
D172393	26.8	36.4	31.6	5.2	6.9	49.3	.8	37.6	.2	4,810	8,660
	---	49.7	43.2	7.1	5.4	67.3	1.1	18.8	.3	6,570	11,830
	---	53.5	46.5	---	5.8	72.5	1.2	20.3	.3	7,080	12,740
D172394	24.8	36.9	29.3	9.0	6.5	47.6	.7	36.0	.2	4,620	8,310
	---	49.1	39.0	12.0	5.0	63.3	.9	18.6	.3	6,140	11,050
	---	55.7	44.3	---	5.7	71.9	1.1	21.1	.3	6,970	12,550
D172395	24.9	35.5	31.4	8.2	6.6	48.2	.7	36.1	.2	4,700	8,460
	---	47.3	41.8	10.9	5.1	64.2	.9	18.6	.3	6,260	11,260
	---	53.1	46.9	---	5.7	72.0	1.0	20.9	.3	7,030	12,650
D172396	23.0	38.1	32.2	6.7	6.4	52.2	.8	33.7	.2	5,120	9,210
	---	49.5	41.8	8.7	5.0	67.8	1.0	17.2	.3	6,650	11,960
	---	54.2	45.8	---	5.5	74.3	1.1	18.9	.3	7,280	13,100
D175053*	32.7	32.6	25.5	9.2	6.6	39.0	.5	44.6	.1	3,590	6,460
	---	48.4	37.9	13.7	4.4	57.9	.7	23.1	.1	5,330	9,600
	---	56.1	43.9	---	5.1	67.1	.9	26.7	.2	6,180	11,120
D186043*	23.8	36.1	27.9	12.2	6.1	43.6	.6	37.3	.2	4,170	7,510
	---	47.4	36.6	16.0	4.5	57.2	.8	21.2	.3	5,470	9,850
	---	56.4	43.6	---	5.4	68.1	.9	25.2	.3	6,520	11,730
D186045*	18.8	38.9	33.3	9.0	5.9	49.8	.7	34.2	.3	4,750	8,540
	---	47.9	41.0	11.1	4.7	61.3	.9	21.5	.4	5,840	10,520
	---	53.9	46.1	---	5.3	69.0	1.0	24.2	.4	6,570	11,830

Table 2.--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 Healy quadrangle, Alaska--Continued

Sample number	Air-dried loss	Forms of sulfur			Free swelling index	Ash fusion temperature, °C		
		Sulfate	Pyritic	Organic		Initial deformation	Softening	Fluid
D172389	13.7	0.01	0.07	0.13	B	B	B	B
	---	.01	.09	.17				
	---	.01	.10	.19				
D172390	10.4	.01	.09	.07	B	B	B	B
	---	.01	.12	.09				
	---	.01	.13	.10				
D172391	11.1	.01	.07	.12	B	B	B	B
	---	.01	.09	.16				
	---	.01	.10	.17				
D172392	5.8	.01	.07	.17	B	B	B	B
	---	.01	.08	.20				
	---	.02	.14	.34				
D172393	14.2	.01	.10	.09	B	B	B	B
	---	.01	.14	.12				
	---	.01	.15	.13				
D172394	12.8	.01	.08	.14	B	B	B	B
	---	.01	.11	.19				
	---	.02	.12	.21				
D172395	12.9	.01	.07	.11	B	B	B	B
	---	.01	.09	.15				
	---	.01	.10	.16				
D172396	12.1	.01	.11	.12	B	B	B	B
	---	.01	.14	.16				
	---	.01	.16	.17				
D175053*	23.7	.02	.01	.11	B	B	B	B
	---	.03	.01	.16				
	---	.03	.02	.19				
D186043*	12.5	.03	.06	.13	B	1,265	1,320	1,375
	---	.04	.08	.17				
	---	.05	.09	.20				
D186045*	7.7	.01	.06	.24	B	1,170	1,210	1,275
	---	.01	.07	.30				
	---	.01	.08	.33				

Table 2.--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 Healy quadrangle, Alaska--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
D186048*	28.5	35.9	28.2	7.4	6.5	44.3	0.7	40.5	0.7	4,210	7,580
	---	50.2	39.4	10.3	4.7	62.0	1.0	21.2	1.0	5,890	10,600
	---	56.0	44.0	---	5.2	69.1	1.1	23.7	1.1	6,570	11,830

Sample number	Air-dried loss	Forms of sulfur			Free swelling index	Ash fusion temperature, °C		
		Sulfate	Pyritic	Organic		Initial deformation	Softening	Fluid
D186048*	17.5	0.04	0.12	0.51	B	1,270	1,325	1,385
	---	.06	.17	.71				
	---	.06	.19	.80				

Table 3.--Major- and minor-oxide and trace element composition of the laboratory ash of 20 coal samples from the Healy quadrangle, Alaska

[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
D172389	8.7	32	18	14	4.10	0.53	0.78	2.0	0.69	0.52	D172389
D172390	11.4	48	19	10	5.65	.36	1.2	1.9	.78	.27	D172390
D172391	9.3	37	19	11	4.13	.42	1.3	3.4	.82	.15	D172391
D172392	37.5	51	23	2.0	1.91	.28	2.8	2.0	1.0	.10L	D172392
D172393	6.8	22	19	17	7.35	.15	.72	4.2	.75	.79	D172393
D172394	11.6	38	22	9.3	3.95	.14	1.4	2.9	1.1	.34	D172394
D172395	11.2	37	20	9.9	3.53	.14	1.3	9.1	.85	.71	D172395
D172396	8.5	41	23	11	2.60	.12	1.0	3.4	1.1	1.2	D172396
D175053	8.3	25	18	20	3.86	.09L	.47	2.2	.87	.11	D175053
D175054	6.5	17	14	29	5.24	.09L	.29	2.9	.57	.13	D175054
D175055	22.6	50	20	8.2	2.01	.11	1.6	1.7	.94	.10L	D175055
D175056	12.9	35	16	20	3.17	.09L	.65	3.1	.79	.10L	D175056
D175057	11.7	38	9.1	20	3.47	.09L	.37	2.7	.87	.10L	D175057
D186043	12.4	34	14	31	2.15	.17	1.2	7.2	.90	1.0L	D186043
D186044	17.9	45	18	20	1.65	.15	1.6	6.7	.92	1.0L	D186044
D186045	18.7	46	17	16	1.67	.18	1.7	4.5	.94	1.0L	D186045
D186046	9.4	28	14	34	2.73	.21	1.0	8.7	.94	1.0L	D186046
D186047	8.9	25	9.6	36	2.88	.20	.77	9.1	1.0	1.0L	D186047
D186048	9.4	28	11	29	1.86	.10	1.0	6.9	.92	1.0L	D186048
D186049	10.2	16	8.3	37	2.50	.09	.62	7.2	.70	1.0L	D186049

Table 3.--Major- and minor-oxide and trace element composition of the laboratory ash of 20 coal samples from the Healy quadrangle, Alaska--Continued

Sample number	SO3 (percent)	Ag-S (ppm)	B-S (ppm)	Ba-S (ppm)	Be-S (ppm)	Cd (ppm)	Co-S (ppm)	Cr-S (ppm)	Cu (ppm)	Ga-S (ppm)	Sample number
D172389	6.6	1	1,000	7,000	5	1.0L	70	150	158	30	D172389
D172390	5.5	1	500	3,000	N	1.0	70	150	86	30	D172390
D172391	6.8	1.5	1,000	5,000	7	1.5	70	150	266	30	D172391
D172392	1.2	N	200	1,500	7	1.5	30	200	130	30	D172392
D172393	9.4	1	1,500	10,000	3	1.0	100	150	202	30	D172393
D172394	5.6	1	700	7,000	3	1.0L	20	150	180	30	D172394
D172395	5.8	N	700	10,000	3	1.0L	15	150	148	30	D172395
D172396	6.3	1.5	700	15,000	3	1.5	50	150	210	30	D172396
D175053	3.7	N	300	5,000	15	1.0	50	150	132	30	D175053
D175054	5.3	N	200	5,000	N	2.0	30	100	130	30	D175054
D175055	1.0	N	150	2,000	N	2.0	10	150	100	30	D175055
D175056	2.5	N	200	3,000	N	1.0	10	150	83	30	D175056
D175057	3.3	N	300	2,000	N	1.0L	20	100	70	20	D175057
D186043	3.5	N	150	2,000	N	1.0L	15	100	130	20	D186043
D186044	2.8	N	70	1,500	N	1.0L	15	100	142	30	D186044
D186045	7.8	1.5	150	3,000	5	2.5	15	150	311	30	D186045
D186046	7.6	N	200	3,000	3	1.0L	15	150	186	20	D186046
D186047	7.5	N	150	5,000	N	1.0L	50	70	110	15	D186047
D186048	19	3	150	2,000	3	3.5	70	200	305	15	D186048
D186049	27	1	150	1,500	3	1.0L	70	150	182	15	D186049

Table 3.--Major- and minor-oxide and trace element composition of the laboratory ash of 20 coal samples from the Healy quadrangle, Alaska--Continued

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
D172389	N	35	70	15	20L	B	150	50	30	1,500	D172389
D172390	100L	36	70	15	20	N	100	55	20	700	D172390
D172391	100	40	200	15	20	150L	150	50	30	700	D172391
D172392	100L	85	70	N	20	150L	70	40	30	200	D172392
D172393	150	43	150	15	20L	150L	150	50	30	3,000	D172393
D172394	100	68	70	10	20L	150L	100	50	30	1,000	D172394
D172395	100L	51	500	10	20L	N	150	40	30	2,000	D172395
D172396	100L	56	150	15	20	N	150	55	30	3,000	D172396
D175053	100	28	1,380	20	20L	N	70	50	50	700	D175053
D175054	100L	20	1,540	20	20L	N	70	30	30	1,500	D175054
D175055	100L	49	450	10	20L	N	30	40	30	700	D175055
D175056	N	40	930	20	20L	B	50	45	30	700	D175056
D175057	N	28	1,130	10	20	B	50	25L	15	700	D175057
D186043	N	19	1,140	7	30	B	70	40	30	1,000	D186043
D186044	N	25	1,230	7	20	B	50	30	30	500	D186044
D186045	100	34	420	15	20	150	50	65	30	700	D186045
D186046	N	21	845	7	N	B	100	45	30	1,500	D186046
D186047	N	17	980	7	30	B	70	45	20	1,500	D186047
D186048	B	16	490	20	20	150	150	30	50	1,000	D186048
D186049	N	13	1,140	15	20	B	150	25L	30	1,500	D186049

Table 3.--Major- and minor-oxide and trace element composition of the laboratory ash of 20 coal samples from the Healy quadrangle, Alaska--Continued

Sample number	V-S (ppm)	Y-S (ppm)	Yb-S (ppm)	Zn (ppm)	Zr-S (ppm)
D172389	200	30	5	26	200
D172390	200	30	3	30	150
D172391	300	70	7	46	150
D172392	300	50	7	99	150
D172393	300	70	7	37	150
D172394	300	30	7	35	150
D172395	200	30	7	70	150
D172396	300	50	7	76	150
D175053	300	70	7	52	150
D175054	300	50	5	56	150
D175055	300	30	3	38	150
D175056	200	100	5	49	150
D175057	150	30	3	31	150
D186043	150	30	3	156	70
D186044	150	50	5	164	70
D186045	300	70	7	244	100
D186046	300	70	7	204	70
D186047	150	50	5	161	70
D186048	300	70	7	343	100
D186049	150	70	7	167	70

Table 4.--Contents of seven trace elements in 20 coal samples from the Healy quadrangle, Alaska

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

Sample number	As (ppm)	F (ppm)	Hg (ppm)	Sb (ppm)	Se (ppm)	Th (ppm)	U (ppm)	Sample number
D172389	2.0	90	0.03	2.0	0.4	4.2	1.3	D172389
D172390	2.0	105	.03	2.2	.6	6.3	1.5	D172390
D172391	3.0	95	.05	2.5	.3	3.1	1.9	D172391
D172392	5.0	335	.30	8.1	11	18	5.2	D172392
D172393	2.0	95	.04	1.8	3.2	3.0	1.3	D172393
D172394	2.0	115	.04	3.1	4.3	9.5	2.0	D172394
D172395	2.0	110	.05	1.8	3.5	7.0	1.4	D172395
D172396	2.0	130	.05	2.0	.1L	4.2	1.4	D172396
D175053	2.0	50	.04	.7	.9	4.9	.5	D175053
D175054	2.0	50	.02	.5	.5	3.0L	.6	D175054
D175055	2.0	165	.08	1.4	.7	4.3	.5	D175055
D175056	2.0	35	.04	.7	.7	3.0L	.8	D175056
D175057	1.0	50	.05	.5	.6	3.0L	.6	D175057
D186043	1.6	55	.09	.6	.1L	1.3	.8	D186043
D186044	2.3	90	.09	.7	.1L	1.7	1.0	D186044
D186045	10	130	.14	5.1	2.1	7.4	3.3	D186045
D186046	3.3	55	.07	.9	.5	1.6	1.1	D186046
D186047	2.2	45	.05	.3	.1L	.7	.5	D186047
D186048	6.6	65	.11	1.5	1.5	2.1	.9	D186048
D186049	5.4	60	.10	.9	1.1	1.3	.4	D186049

Table 5.--Major-, minor-, and trace-element composition of 20 coal samples from the Healy quadrangle, Alaska

[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; 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)	Ag-S (ppm)	As (ppm)	Sample number
D172389	1.3	0.84	0.86	0.22	0.034	0.057	0.12	0.036	0.1	2.0	D172389
D172390	2.6	1.2	.84	.39	.030	.11	.15	.053	.1	2.0	D172390
D172391	1.6	.95	.71	.23	.029	.10	.22	.046	.15	3.0	D172391
D172392	8.9	4.6	.55	.43	.078	.87	.52	.23	N	5.0	D172392
D172393	.70	.69	.85	.30	.008	.041	.20	.031	.07	2.0	D172393
D172394	2.1	1.4	.77	.28	.012	.13	.23	.074	.1	2.0	D172394
D172395	1.9	1.2	.79	.24	.012	.12	.71	.057	N	2.0	D172395
D172396	1.6	1.0	.65	.13	.008	.073	.20	.056	.15	2.0	D172396
D175053	.97	.79	1.2	.19	.006L	.033	.13	.043	N	2.0	D175053
D175054	.52	.48	1.3	.21	.004L	.016	.13	.022	N	2.0	D175054
D175055	5.3	2.4	1.3	.27	.018	.31	.27	.13	N	2.0	D175055
D175056	2.1	1.1	1.8	.25	.009L	.070	.28	.061	N	2.0	D175056
D175057	2.1	.56	1.7	.24	.008L	.036	.22	.061	N	1.0	D175057
D186043	2.0	.92	2.7	.16	.016	.12	.62	.067	N	1.6	D186043
D186044	3.8	1.7	2.6	.18	.020	.24	.84	.099	N	2.3	D186044
D186045	4.0	1.7	2.1	.19	.025	.26	.59	.11	.3	10	D186045
D186046	1.2	.70	2.3	.15	.015	.078	.57	.053	N	3.3	D186046
D186047	1.0	.45	2.3	.15	.013	.057	.57	.053	N	2.2	D186047
D186048	1.2	.55	1.9	.11	.007	.078	.45	.052	.3	6.6	D186048
D186049	.76	.45	2.7	.15	.007	.053	.51	.043	.1	5.4	D186049

Table 5.--Major, minor-, and trace-element composition of 20 coal samples from the Healy quadrangle, Alaska--Continued

Sample number	B-S (ppm)	Ba-S (ppm)	Be-S (ppm)	Cd (ppm)	Co-S (ppm)	Cr-S (ppm)	Cu (ppm)	F (ppm)	Ga-S (ppm)	Hg (ppm)	Sample number
D172389	100	700	0.5	0.09L	7	15	14	90	3	0.03	D172389
D172390	70	300	N	.11	7	15	9.8	105	3	.03	D172390
D172391	100	500	.7	.14	7	15	25	95	3	.05	D172391
D172392	70	700	3	.56	10	70	49	335	10	.30	D172392
D172393	100	700	.2	.07	7	10	14	95	2	.04	D172393
D172394	70	700	.3	.12L	2	15	21	115	3	.04	D172394
D172395	70	1,000	.3	.11L	1.5	15	17	110	3	.05	D172395
D172396	70	1,500	.2	.13	5	15	18	130	2	.05	D172396
D175053	20	500	1.5	.08	5	15	11	50	2	.04	D175053
D175054	15	300	N	.13	2	7	8.5	50	2	.02	D175054
D175055	30	500	N	.45	2	30	23	165	7	.08	D175055
D175056	20	500	N	.13	1.5	20	11	35	5	.04	D175056
D175057	30	200	N	.12L	2	10	8.2	50	2	.05	D175057
D186043	20	200	N	.12L	2	15	16	55	2	.09	D186043
D186044	15	300	N	.18L	3	20	25	90	5	.09	D186044
D186045	30	500	1	.47	3	30	58	130	5	.14	D186045
D186046	20	300	.3	.09L	1.5	15	17	55	2	.07	D186046
D186047	15	500	N	.09L	5	7	9.8	45	1.5	.05	D186047
D186048	15	200	.3	.33	7	20	29	65	1.5	.11	D186048
D186049	15	150	.3	.10L	7	15	19	60	1.5	.10	D186049

Table 5.--Major, minor-, and trace-element composition of 20 coal samples from the Healy quadrangle, Alaska--Continued

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
D172389	N	3.1	6.1	1.5	1.5L	B	15	200	4.4	2.0	D172389
D172390	10L	4.1	8.0	1.5	2	N	10	130	6.3	2.2	D172390
D172391	10	3.7	19	1.5	2	15L	15	61	4.7	2.5	D172391
D172392	30L	32	26	N	7	70L	30	160L	15	8.1	D172392
D172393	10	2.9	10	1	1.5L	10L	10	240	3.4	1.8	D172393
D172394	10	7.9	8.1	1	2L	15L	10	170	5.8	3.1	D172394
D172395	10L	5.7	56	1	2L	N	15	350	4.5	1.8	D172395
D172396	10L	4.8	13	1.5	1.5	N	15	450	4.7	2.0	D172396
D175053	10	2.3	110	1.5	1.5L	N	7	40	4.2	.7	D175053
D175054	7L	1.3	100	1.5	1.5L	N	5	37	2.0	.5	D175054
D175055	20L	11	100	2	5L	N	7	99L	9.0	1.4	D175055
D175056	N	5.2	120	2	2L	B	7	56L	5.8	.7	D175056
D175057	N	3.3	130	1	2	B	7	51L	2.9L	.5	D175057
D186043	N	2.4	140	1	3	B	10	540L	5.0	.6	D186043
D186044	N	4.5	220	1.5	3	B	10	780L	5.4	.7	D186044
D186045	20	6.4	79	3	3	30	10	820L	12	5.1	D186045
D186046	N	2.0	79	.7	N	B	10	410L	4.2	.9	D186046
D186047	N	1.5	87	.7	3	B	7	390L	4.0	.3	D186047
D186048	B	1.5	46	2	2	15	15	410L	2.8	1.5	D186048
D186049	N	1.3	120	1.5	2	B	15	450L	2.6L	.9	D186049

Table 5.--Major, minor-, and trace-element composition of 20 coal samples from the Healy quadrangle, Alaska--Continued

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
D172389	3	0.4	150	4.2	1.3	15	3	0.5	2.3	15	D172389
D172390	2	.6	70	6.3	1.5	20	3	.3	3.4	15	D172390
D172391	3	.3	70	3.1	1.9	30	7	.7	4.3	15	D172391
D172392	10	11	70	17.5	5.2	100	20	3	37	70	D172392
D172393	2	3.2	200	3.0	1.3	20	5	.5	2.5	10	D172393
D172394	3	4.3	100	9.5	2.0	30	3	.7	4.1	15	D172394
D172395	3	3.5	200	7.0	1.4	20	3	.7	7.8	15	D172395
D172396	2	.1L	200	4.2	1.4	20	5	.7	6.5	15	D172396
D175053	5	.9	70	4.9	.5	20	7	.7	4.3	15	D175053
D175054	2	.5	100	3.0L	.6	20	3	.3	3.6	10	D175054
D175055	7	.7	150	4.3	.5	70	7	.7	8.6	30	D175055
D175056	5	.7	100	3.0L	.8	20	15	.7	6.3	20	D175056
D175057	1.5	.6	70	3.0L	.6	15	3	.3	3.6	15	D175057
D186043	3	.1L	150	1.3	.8	20	3	.3	19	10	D186043
D186044	5	.1L	100	1.7	1.0	30	10	1	29	15	D186044
D186045	5	2.1	150	7.4	3.3	50	15	1.5	46	20	D186045
D186046	3	.5	150	1.6	1.1	30	7	.7	19	7	D186046
D186047	2	.1L	150	.7	.5	15	5	.5	14	7	D186047
D186048	5	1.5	100	2.1	.9	30	7	.7	32	10	D186048
D186049	3	1.1	150	1.3	.4	15	7	.7	17	7	D186049

Table 6.--Proximate and ultimate analyses, and heat-of-combustion, forms-of-sulfur, free-swelling-index and ash-fusion-temperature determinations for 10 coal samples from the Kenai quadrangle, Alaska

[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 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
D178628	23.4	41.5	30.3	4.8	6.6	46.2	0.9	40.2	1.3	4,350	7,830
	---	54.2	39.6	6.3	5.2	60.3	1.2	25.3	1.7	5,680	10,220
	---	57.8	42.2	---	5.6	64.3	1.3	27.0	1.8	6,060	10,910
D178629	26.5	30.4	24.5	18.6	6.1	36.8	.7	37.6	.2	3,510	6,320
	---	41.4	33.3	25.3	4.3	50.1	1.0	19.1	.3	4,780	8,600
	---	55.4	44.6	---	5.7	67.0	1.3	25.6	.4	6,400	11,510
D178630	22.3	35.6	25.7	16.4	6.2	40.4	.8	36.0	.2	3,860	6,950
	---	45.8	33.1	21.1	4.8	52.0	1.0	20.8	.3	4,970	8,940
	---	58.1	41.9	---	6.1	65.9	1.3	26.4	.3	6,300	11,340
D178773	18.9	41.7	33.1	6.3	6.3	50.4	1.1	35.6	.3	4,770	8,580
	---	51.4	40.8	7.8	5.2	62.1	1.4	23.2	.4	5,880	10,580
	---	55.7	44.3	---	5.6	67.4	1.5	25.1	.4	6,370	11,470
D178774	20.7	36.5	29.5	13.3	6.1	44.7	.7	34.9	.3	4,320	7,780
	---	46.0	37.2	16.8	4.8	56.4	.9	20.8	.4	5,450	9,810
	---	55.3	44.7	---	5.8	67.7	1.1	25.0	.5	6,550	11,790
D178775	21.6	39.3	31.2	7.9	6.4	47.9	.7	36.8	.3	4,620	8,310
	---	50.1	39.8	10.1	5.1	61.1	.9	22.4	.4	5,890	10,600
	---	55.7	44.3	---	5.7	67.9	1.0	25.0	.4	6,550	11,790
D178776	18.0	43.2	30.9	7.9	6.0	49.5	1.0	35.3	.3	4,660	8,390
	---	52.7	37.7	9.6	4.9	60.4	1.2	23.5	.4	5,680	10,230
	---	58.3	41.7	---	5.4	66.8	1.3	26.0	.4	6,290	11,320
D178777	20.2	34.3	21.7	23.8	5.5	38.1	.7	31.6	.3	3,660	6,590
	---	43.0	27.2	29.8	4.1	47.7	.9	17.1	.4	4,590	8,260
	---	61.2	38.7	---	5.8	68.0	1.2	24.4	.5	6,540	11,770
D178778	25.1	30.0	22.5	22.4	5.9	35.4	.6	35.4	.3	3,430	6,170
	---	40.1	30.0	29.9	4.2	47.3	.8	17.5	.4	4,580	8,240
	---	57.1	42.9	---	5.9	67.4	1.1	24.9	.6	6,530	11,750
D178779	20.1	32.5	20.5	26.9	5.3	35.9	.7	30.8	.4	3,460	6,220
	---	40.7	25.7	33.7	3.8	44.9	.9	16.2	.5	4,320	7,780
	---	61.3	38.7	---	5.8	67.7	1.3	24.4	.8	6,520	11,740

Table 6.--Proximate and ultimate analyses, and heat-of-combustion, forms-of-sulfur, free-swelling-index and ash-fusion-temperature determinations for 10 coal samples from the Kenai quadrangle, Alaska--Continued

Sample number	Air-dried loss	Forms of sulfur			Free swelling	Ash fusion temperature,°C		
		Sulfate	Pyritic	Organic		Initial deformation	Softening	Fluid
D178628	17.5	0.03	0.01	1.29	B	1,020	1,045	1,065
	---	.04	.01	1.68				
	---	.04	.01	1.80				
D178629	19.3	.02	.01	.22	B	1,070	1,170	1,275
	---	.03	.01	.30				
	---	.04	.02	.40				
D178630	16.2	.02	.01	.19	B	1,060	1,165	1,265
	---	.03	.01	.24				
	---	.03	.02	.31				
D178773	B	.02	.06	.17	B	1,240	1,290	1,340
	---	.02	.07	.21				
	---	.03	.08	.23				
D178774	B	.02	.12	.17	B	1,175	1,220	1,275
	---	.03	.15	.21				
	---	.03	.18	.26				
D178775	B	.02	.07	.21	B	1,080	1,135	1,180
	---	.03	.09	.27				
	---	.03	.10	.30				
D178776	B	.02	.10	.16	B	1,140	1,190	1,230
	---	.02	.12	.20				
	---	.03	.13	.22				
D178777	B	.02	.06	.20	B	1,130	1,195	1,240
	---	.03	.08	.25				
	---	.04	.11	.36				
D178778	B	.02	.05	.26	B	1,100	1,160	1,205
	---	.03	.07	.35				
	---	.04	.10	.50				
D178779	B	.02	.06	.28	B	1,185	1,230	1,280
	---	.03	.08	.35				
	---	.04	.11	.53				

Table 7.--Major- and minor-oxide and trace element composition of the laboratory ash of 10 coal samples from the Kenai quadrangle, Alaska

[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
D178628	5.8	24	13	16	3.90	0.61	0.76	14	0.71	1.0L	D178628
D178629	14.9	48	19	4.1	5.16	6.13	1.7	3.3	.97	1.0L	D178629
D178630	15.9	45	21	4.9	5.02	4.13	1.8	3.8	.93	1.0L	D178630
D178773	6.1	16	11	23	8.31	.40	.39	7.3	.57	1.8	D178773
D178774	14.0	46	16	11	4.23	1.75	1.1	2.6	.60	1.0L	D178774
D178775	8.9	32	16	12	6.50	6.13	1.2	3.4	.64	1.0	D178775
D178776	8.9	54	19	5.0	6.00	3.63	4.1	8.2	.92	1.0	D178776
D178777	25.7	47	16	6.2	3.58	1.28	1.3	4.1	.66	1.0L	D178777
D178778	25.7	50	16	4.2	3.70	2.95	1.5	3.9	.66	1.0L	D178778
D178779	23.3	50	17	4.8	3.28	2.40	1.4	2.2	.83	1.0L	D178779

Sample number	SO3 (percent)	B-S (ppm)	Ba-S (ppm)	Be-S (ppm)	Co-S (ppm)	Cr-S (ppm)	Cu (ppm)	Ga-S (ppm)	Li (ppm)	Mn (ppm)	Sample number
D178628	6.8	150	7,000	N	100	100	129	30	17	5,030	D178628
D178629	2.5	500	3,000	3	30	300	139	50	39	330	D178629
D178630	4.1	200	3,000	3	50	150	152	50	47	420	D178630
D178773	6.7	500	10,000	3	100	100	121	20	10L	3,920	D178773
D178774	3.3	150	3,000	3	70	150	93	30	23	775	D178774
D178775	6.4	200	5,000	7	70	150	195	30	32	815	D178775
D178776	6.1	150	7,000	5	70	200	185	30	32	710	D178776
D178777	2.3	70	3,000	3	30	100	115	30	39	745	D178777
D178778	2.8	150	2,000	5	30	150	111	30	43	855	D178778
D178779	3.6	150	2,000	3	30	150	151	50	56	615	D178779

Table 7.--Major- and minor-oxide and trace element composition of the laboratory ash of 10 coal samples from the Kenai quadrangle, Alaska--Continued

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)	Sample number
D178628	30	N	100	25L	20	1,000	300	70	7	44	D178628
D178629	15	20	70	25L	30	2,000	1,000	70	10	66	D178629
D178630	15	20	100	25L	30	1,000	500	70	7	80	D178630
D178773	50	20L	100	25L	30	3,000	300	70	7	44	D178773
D178774	15	20	70	25L	20	300	300	70	7	27	D178774
D178775	30	20	70	25	30	700	500	100	15	53	D178775
D178776	30	20	150	25L	30	1,000	500	100	15	56	D178776
D178777	15	20	70	25L	30	300	300	70	7	95	D178777
D178778	15	30	70	25L	30	700	300	70	7	75	D178778
D178779	15	30	70	25L	30	500	500	70	7	37	D178779

Sample number	Zr-S (ppm)
D178628	100
D178629	150
D178630	150
D178773	100
D178774	150
D178775	200
D178776	150
D178777	150
D178778	150
D178779	150

Table 8.--Contents of seven trace elements in 10 coal samples from the Kenai quadrangle, Alaska

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

Sample number	As (ppm)	F (ppm)	Hg (ppm)	Sb (ppm)	Se (ppm)	Th (ppm)	U (ppm)	Sample number
D178628	2.0	20	0.04	0.3	0.1L	3.0L	0.2L	D178628
D178629	3.5	35	.07	.7	.1	3.0L	.7	D178629
D178630	3.0	40	.07	.7	.2	4.1	.9	D178630
D178773	3.0	20L	.01	.2	.1L	3.0L	.2L	D178773
D178774	3.0	20	.04	.4	.1	3.0L	.5	D178774
D178775	3.5	25	.05	.8	.1L	3.0L	.7	D178775
D178776	3.0	20	.05	.6	.2	3.0L	.5	D178776
D178777	5.0	60	.09	.7	.3	3.0L	1.2	D178777
D178778	4.5	55	.12	1.1	.1	3.0L	.9	D178778
D178779	4.0	75	.09	1.3	.2	3.0L	1.2	D178779

Table 9.--Major-, minor-, and trace-element composition of 10 coal samples from the Kenai quadrangle, Alaska

[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; 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
D178628	0.64	0.40	0.65	0.14	0.026	0.037	0.57	0.025	2.0	10	D178628
D178629	3.3	1.5	.44	.46	.68	.21	.35	.087	3.5	70	D178629
D178630	3.3	1.8	.56	.48	.49	.24	.42	.089	3.0	30	D178630
D178773	.46	.35	1.0	.31	.018	.020	.31	.021	3.0	30	D178773
D178774	3.0	1.2	1.1	.36	.18	.13	.25	.050	3.0	20	D178774
D178775	1.3	.76	.74	.35	.40	.087	.21	.034	3.5	20	D178775
D178776	2.2	.89	.32	.32	.24	.30	.51	.049	3.0	15	D178776
D178777	5.7	2.1	1.1	.55	.24	.27	.74	.10	5.0	20	D178777
D178778	6.0	2.2	.78	.57	.56	.32	.70	.10	4.5	50	D178778
D178779	5.5	2.1	.79	.46	.41	.27	.36	.12	4.0	30	D178779

Sample number	Ba-S (ppm)	Be-S (ppm)	Co-S (ppm)	Cr-S (ppm)	Cu (ppm)	F (ppm)	Ga-S (ppm)	Hg (ppm)	Li (ppm)	Mn (ppm)	Sample number
D178628	500	N	7	7	7.5	20	1.5	0.04	1.0	290	D178628
D178629	500	.5	5	50	21	35	7	.07	5.8	49	D178629
D178630	500	.5	7	20	24	40	7	.07	7.5	67	D178630
D178773	700	.2	7	7	7.4	20L	1.5	.01	.6L	240	D178773
D178774	500	.5	10	20	13	20	5	.04	3.2	110	D178774
D178775	500	.7	7	15	17	25	3	.05	2.8	73	D178775
D178776	700	.5	7	20	16	20	3	.05	2.8	63	D178776
D178777	700	.7	7	20	30	60	7	.09	10	190	D178777
D178778	500	1.5	7	50	29	55	7	.12	11	220	D178778
D178779	500	.7	7	30	35	75	10	.09	13	140	D178779

Table 9.--Major-, minor-, and trace-element composition of 10 coal samples from the Kenai quadrangle, Alaska--Continued

Sample number	Mo-S (ppm)	Nb-S (ppm)	Ni-S (ppm)	P (ppm)	Pb (ppm)	Sb (ppm)	Sc-S (ppm)	Se (ppm)	Sr-S (ppm)	Th (ppm)	Sample number
D178628	1.5	N	7	250L	1.5L	0.3	1	0.1L	70	3.0L	D178628
D178629	2	3	10	650L	3.7L	.7	5	.1	300	3.0L	D178629
D178630	2	3	15	690L	4.0L	.7	5	.2	150	4.1	D178630
D178773	3	1.5L	7	470	1.5L	.2	2	.1L	200	3.0L	D178773
D178774	2	3	10	610L	3.5L	.4	3	.1	50	3.0L	D178774
D178775	3	2	7	400	2.2	.8	3	.1L	70	3.0L	D178775
D178776	3	2	15	390	2.2L	.6	3	.2	100	3.0L	D178776
D178777	5	5	20	1,100L	6.4L	.7	7	.3	70	3.0L	D178777
D178778	5	7	20	1,100L	6.4L	1.1	7	.1	200	3.0L	D178778
D178779	3	7	15	1,000L	5.8L	1.3	7	.2	100	3.0L	D178779

Sample number	U (ppm)	V-S (ppm)	Y-S (ppm)	Yb-S (ppm)	Zn (ppm)	Zr-S (ppm)	Sample number
D178628	0.2L	15	5	0.5	2.6	7	D178628
D178629	.7	150	10	1.5	9.8	20	D178629
D178630	.9	70	10	1	13	20	D178630
D178773	.2L	20	5	.5	2.7	7	D178773
D178774	.5	50	10	1	3.8	20	D178774
D178775	.7	50	10	1.5	4.7	20	D178775
D178776	.5	50	10	1.5	5.0	15	D178776
D178777	1.2	70	20	2	24	50	D178777
D178778	.9	70	20	2	19	50	D178778
D178779	1.2	100	15	1.5	8.6	30	D178779

Table 10.--Proximate and ultimate analyses, and heat-of-combustion, forms-of-sulfur, free-swelling-index and ash-fusion-temperature determinations for 6 coal samples from the Seldovia quadrangle, Alaska

[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); $^{o}F = (C^{o} \times 1.8) + 32$; 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
D169228	11.0	38.4	27.1	23.5	5.2	45.4	0.9	24.6	0.4	4,380	7,890
	---	43.1	30.4	26.4	4.5	51.0	1.0	16.7	.4	4,930	8,870
	---	58.6	41.4	---	6.1	69.3	1.4	22.6	.6	6,690	12,050
D169229	15.6	40.4	33.0	11.0	5.9	50.0	1.0	31.7	.4	4,780	8,610
	---	47.9	39.1	13.0	4.9	59.2	1.2	21.1	.5	5,670	10,200
	---	55.0	45.0	---	5.7	68.1	1.4	24.3	.5	6,520	11,730
D169230	13.5	39.6	28.3	18.6	5.5	46.1	1.0	28.4	.4	4,460	8,030
	---	45.8	32.7	21.5	4.6	53.3	1.2	19.0	.5	5,160	9,280
	---	58.3	41.7	---	5.9	67.9	1.5	24.2	.6	6,570	11,830
D169231	16.8	40.8	32.3	10.1	5.7	48.2	1.1	34.6	.3	4,540	8,170
	---	49.0	38.8	12.1	4.6	57.9	1.3	23.6	.4	5,460	9,820
	---	55.8	44.2	---	5.2	65.9	1.5	26.9	.4	6,210	11,180
D169232	18.6	41.4	30.9	9.1	6.0	48.3	1.1	35.2	.3	4,560	8,200
	---	50.9	38.0	11.2	4.8	59.3	1.4	22.9	.4	5,600	10,070
	---	57.3	42.7	---	5.4	66.8	1.5	25.8	.4	6,300	11,340
D169233	22.3	40.0	29.4	8.3	6.3	46.2	1.0	37.9	.3	4,400	7,920
	---	51.5	37.8	10.7	4.9	59.5	1.3	23.3	.4	5,660	10,190
	---	57.6	42.4	---	5.5	66.6	1.4	26.0	.4	6,340	11,410

Table 10.--Proximate and ultimate analyses, and heat-of-combustion, forms-of-sulfur, free-swelling-index and ash-fusion-temperature determinations for 6 coal samples from the Seldovia quadrangle, Alaska--Continued

Sample number	Air-dried loss	Forms of sulfur			Free swelling	Ash fusion temperature,°C		
		Sulfate	Pyritic	Organic		Initial deformation	Softening	Fluid
D169228	B	0.01	0.03	0.36	B	B	B	B
	---	.01	.03	.40				
	---	.02	.05	.55				
D169229	1.6	.01	.01	.42	B	B	B	B
	---	.01	.01	.50				
	---	.01	.01	.57				
D169230	.7	.01	.01	.37	B	B	B	B
	---	.01	.01	.43				
	---	.01	.01	.54				
D169231	1.8	.01	.01	.27	B	B	B	B
	---	.01	.01	.32				
	---	.01	.01	.37				
D169232	3.1	.01	.04	.22	B	B	B	B
	---	.01	.05	.27				
	---	.01	.06	.30				
D169233	6.2	.01	.01	.31	B	B	B	B
	---	.01	.01	.40				
	---	.01	.01	.45				

Table 11.--Major- and minor-oxide and trace element composition of the laboratory ash of 34 coal samples from the Seldovia quadrangle, Alaska

[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
D169228	25.3	50	25	6.7	1.00	0.84	2.8	3.2	0.97	1.2	D169228
D169229	12.3	40	22	11	1.49	.76	2.2	4.7	.94	.64	D169229
D169230	20.1	45	24	11	1.00	.58	2.5	2.6	.96	.10L	D169230
D169231	10.5	35	20	14	1.99	.53	1.7	4.2	.72	1.7	D169231
D169232	10.7	30	15	16	2.64	.42	.93	11	.78	1.9	D169232
D169233	9.3	33	15	16	3.00	.57	.77	7.0	.54	2.0	D169233
D169234	14.1	39	23	11	1.13	2.95	2.5	4.6	.70	.24	D169234
D169236	14.7	39	22	12	1.13	3.15	2.3	4.1	.74	1.1	D169236
D169237	17.1	41	22	11	1.00	2.66	2.5	3.6	.79	.99	D169237
D169238	17.4	42	22	11	1.00	1.35	1.9	4.0	.88	.89	D169238
D169239	20.0	45	23	9.3	1.00	1.25	2.3	4.6	.87	.22	D169239
D169240	9.5	35	14	18	1.38	2.25	1.6	7.0	.58	.10L	D169240
D169241	6.0	17	11	24	2.50	6.38	1.2	7.0	.39	.10L	D169241
D169242	49.1	49	24	2.9	1.38	.88	3.1	6.9	.84	.46	D169242
D169243	12.9	40	19	13	1.24	.65	1.6	4.6	.68	.83	D169243
D169244	15.1	47	20	12	1.24	.66	2.4	3.3	1.1	.25	D169244
D169245	7.7	27	13	18	2.50	.82	1.3	14	.56	.10L	D169245
D169246	40.9	52	23	3.7	1.38	1.40	2.3	6.0	.90	.13	D169246
D169247	10.9	32	18	17	1.99	.57	1.2	5.3	.79	2.2	D169247
D169248	8.7	27	18	20	2.50	.67	.91	4.3	.52	3.1	D169248
D169249	15.1	44	18	10	1.87	.79	1.3	7.9	.63	.81	D169249
D169250	7.1	24	14	22	4.00	.39	.64	7.3	.65	1.7	D169250
D169251	9.0	33	19	16	2.75	.38	.79	5.7	.91	1.6	D169251
D169252	13.4	44	15	11	2.26	.79	1.2	5.7	.76	.10L	D169252
D169253	20.1	49	20	7.1	1.76	.94	1.5	5.5	.97	.10	D169253
D169254	10.9	39	12	13	2.75	.77	.84	11	.69	.31	D169254
D169255	7.9	27	12	19	3.63	.45	.48	11	.54	2.4	D169255
D169256	11.1	33	16	15	3.25	.53	1.1	7.6	.72	1.8	D169256
D169257	25.5	52	22	5.8	1.63	.81	2.2	3.5	.98	.35	D169257
D169258	7.3	14	7.9	25	1.63	4.00	.70	17	.34	.10L	D169258
D169259	8.0	22	18	23	1.49	1.35	1.1	6.6	.72	2.2	D169259
D169260	35.2	54	22	4.4	.75	1.81	2.2	4.1	.99	.10L	D169260
D169261	7.4	19	14	23	1.38	4.30	.79	7.8	.61	1.5	D169261
D169262	7.9	23	15	22	1.38	1.81	1.2	7.8	.65	1.1	D169262

Table 11.--Major- and minor-oxide and trace element composition of the laboratory ash of 34 coal samples from the Seldovia quadrangle, Alaska--Continued

Sample number	SO3 (percent)	B-S (ppm)	Ba-S (ppm)	Be-S (ppm)	Co-S (ppm)	Cr-S (ppm)	Cu (ppm)	Ga-S (ppm)	Ge-S (ppm)	La-S (ppm)	Sample number
D169228	3.1	150	3,000	3	15	150	180	30	N	N	D169228
D169229	6.9	300	2,000	5	50	150	145	20	30	N	D169229
D169230	3.8	150	2,000	N	20	150	122	30	N	N	D169230
D169231	6.5	150	5,000	3	50	150	204	20	N	70	D169231
D169232	5.4	100	5,000	3	50	150	142	20	20L	N	D169232
D169233	8.4	100	5,000	3	30	100	162	15	20L	70	D169233
D169234	4.8	300	5,000	3	70	150	122	30	N	N	D169234
D169236	7.3	200	3,000	3	30	100	124	20	N	N	D169236
D169237	6.3	200	3,000	3	30	150	126	30	N	N	D169237
D169238	4.5	100	5,000	5	30	150	206	30	N	70	D169238
D169239	4.0	100	3,000	3	30	150	204	30	N	N	D169239
D169240	4.6	200	3,000	3	70	100	106	20	20L	N	D169240
D169241	16	300	7,000	3	70	100	184	15	20L	70	D169241
D169242	2.6	70	2,000	3	15	150	112	30	N	N	D169242
D169243	7.0	300	3,000	3	30	100	138	30	N	N	D169243
D169244	5.2	150	2,000	3	20	150	98	30	70	N	D169244
D169245	7.9	150	3,000	N	30	100	236	15	N	N	D169245
D169246	2.3	50	1,500	3	30	150	210	20	N	70	D169246
D169247	9.8	150	7,000	N	30	100	228	15	N	70	D169247
D169248	7.8	150	7,000	3	50	70	121	15	N	70	D169248
D169249	4.3	100	3,000	N	30	100	108	20	N	N	D169249
D169250	6.1	150	3,000	N	30	50	106	15	30	N	D169250
D169251	6.7	100	3,000	7	30	150	140	15	N	70	D169251
D169252	3.4	70	2,000	3	30	100	86	20	N	70	D169252
D169253	3.0	70	1,500	3	20	150	130	30	20L	N	D169253
D169254	6.5	50	1,500	3	50	70	136	20	20L	N	D169254
D169255	5.2	70	5,000	N	50	30	90	20	N	N	D169255
D169256	5.4	50	5,000	3	50	100	128	30	20L	N	D169256
D169257	2.6	70	2,000	3	15	150	112	30	N	N	D169257
D169258	9.3	1,000	5,000	3	100	70	98	B	30	N	D169258
D169259	9.9	500	7,000	3	50	100	206	30	N	70	D169259
D169260	3.7	70	2,000	3	20	150	200	30	N	N	D169260
D169261	9.2	500	10,000	3	100	100	186	20	20L	N	D169261
D169262	11	500	7,000	N	70	100	208	20	N	N	D169262

Table 11.--Major- and minor-oxide and trace element composition of the laboratory ash of 34 coal samples from the Seldovia quadrangle, Alaska--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
D169228	70	500	7	20L	50	30	30	1,500	300	30	D169228
D169229	34	500	10	20L	50	25	30	1,500	700	30	D169229
D169230	62	300	7	20L	30	35	20	1,000	200	20	D169230
D169231	28	500	10	20L	70	30	20	2,000	300	30	D169231
D169232	16	1,000	10	20L	70	25	30	3,000	500	30	D169232
D169233	12	1,500	10	20L	70	25	30	3,000	300	30	D169233
D169234	30	300	50	20L	70	30	20	3,000	300	20	D169234
D169236	36	700	10	20L	50	25L	20	2,000	200	20	D169236
D169237	36	700	10	20L	50	35	20	2,000	300	30	D169237
D169238	40	700	10	20L	70	35	30	2,000	500	50	D169238
D169239	50	500	70	20	70	35	30	1,500	500	30	D169239
D169240	34	500	15	20L	70	25L	15	2,000	150	30	D169240
D169241	10	700	20	N	100	25	20	3,000	150	70	D169241
D169242	20	500	N	20L	30	25L	30	700	200	20	D169242
D169243	30	1,000	15	N	70	25	30	1,500	200	30	D169243
D169244	26	300	7	20	30	25L	30	1,000	500	30	D169244
D169245	26	1,000	30	20L	50	25L	20	1,500	300	30	D169245
D169246	64	300	7	20L	50	25L	30	500	500	50	D169246
D169247	24	500	15	N	50	30	30	3,000	300	50	D169247
D169248	14	700	30	20L	100	25L	30	3,000	300	70	D169248
D169249	32	1,000	7	20L	70	25L	30	1,500	200	30	D169249
D169250	14	1,500	7	20L	70	25L	15	3,000	150	30	D169250
D169251	34	1,000	15	20L	100	25L	50	2,000	500	70	D169251
D169252	24	1,000	7L	20L	50	25L	30	700	500	50	D169252
D169253	48	500	7	20	50	25	30	500	700	30	D169253
D169254	18	1,500	15	20	70	25L	30	1,000	700	30	D169254
D169255	12	1,500	15	N	70	25L	15	3,000	150	30	D169255
D169256	18	1,500	10	20	50	25L	30	2,000	200	30	D169256
D169257	84	500	N	20	50	25	30	500	300	30	D169257
D169258	22	2,000	15	20	100	30	30	3,000	200	50	D169258
D169259	22	500	15	20L	70	30	30	5,000	300	50	D169259
D169260	68	300	7	20L	50	30	30	700	300	30	D169260
D169261	14	700	30	20L	150	25	30	7,000	300	70	D169261
D169262	20	700	15	20L	100	25	20	3,000	300	50	D169262

Table 11.--Major- and minor-oxide and trace element composition of the laboratory ash of 34 coal samples from the Seldovia quadrangle, Alaska--Continued

Sample number	Yb-S (ppm)	Zn (ppm)	Zr-S (ppm)
D169228	3	58	150
D169229	3	35	150
D169230	2	29	150
D169231	3	48	150
D169232	5	30	150
D169233	3	37	150
D169234	3	80	150
D169236	3	50	100
D169237	3	57	100
D169238	5	63	150
D169239	3	68	200
D169240	3	78	100
D169241	7	35	100
D169242	3	230	150
D169243	3	35	100
D169244	3	20	200
D169245	3	106	100
D169246	5	198	200
D169247	3	56	150
D169248	7	38	100
D169249	3	88	100
D169250	3	48	100
D169251	7	38	150
D169252	5	59	200
D169253	3	44	300
D169254	5	52	200
D169255	3	45	100
D169256	3	41	150
D169257	3	53	150
D169258	5	50	150
D169259	5	57	150
D169260	5	79	150
D169261	7	41	150
D169262	5	52	100

Table 12.--Contents of seven trace elements in 34 coal samples from the Seldovia quadrangle Alaska

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

Sample number	As (ppm)	F (ppm)	Hg (ppm)	Sb (ppm)	Se (ppm)	Th (ppm)	U (ppm)	Sample number
D169228	25	130	0.16	1.2	0.3	3.5	1.3	D169228
D169229	8.0	60	.08	1.8	.2	3.0L	.6	D169229
D169230	10	95	.13	1.6	.3	2.7	1.1	D169230
D169231	5.0	60	.08	1.1	.2	3.0L	.6	D169231
D169232	5.0	50	.08	.7	.1L	3.0L	.3	D169232
D169233	8.0	45	.08	.9	.2	2.4	.8	D169233
D169234	10	70	.06	.8	.2	2.2	.6	D169234
D169236	20	75	.08	1.4	1.6	3.0L	.7	D169236
D169237	15	135	.09	1.4	.3	3.0L	.8	D169237
D169238	8.0	90	.11	1.4	.3	2.9	1.1	D169238
D169239	8.0	100	.14	1.3	.3	3.6	1.3	D169239
D169240	8.0	35	.04	.5	.2	1.9	.2L	D169240
D169241	4.0	40	.05	.3	.1L	3.0L	.3	D169241
D169242	20	290	.40	2.1	1.3	6.1	1.9	D169242
D169243	15	70	.06	.8	.2	3.0L	.5	D169243
D169244	8.0	100	.08	1.2	1.3	3.0L	.7	D169244
D169245	3.0	50	.07	.9	.2	3.0L	.3	D169245
D169246	15	250	.23	3.4	1.4	3.5	3.1	D169246
D169247	10	75	.11	1.0	1.4	3.0L	.6	D169247
D169248	8.0	20	.05	.9	1.2	2.7	.3	D169248
D169249	5.0	40	.07	.9	1.7	2.3	.7	D169249
D169250	2.0	30	.05	.4	1.3	1.9	.2L	D169250
D169251	4.0	30	.07	.6	.1L	2.5	.3	D169251
D169252	4.0	65	.08	.6	2.0	2.8	.2L	D169252
D169253	8.0	65	.14	1.2	.1L	4.0	.4	D169253
D169254	10	25	.05	1.3	2.1	2.3	.2L	D169254
D169255	3.0	25	.03	.2	.1L	3.2	.2L	D169255
D169256	5.0	30	.07	.8	1.8	1.9	.4	D169256
D169257	8.0	105	.09	1.2	1.8	3.4	1.0	D169257
D169258	3.0	20L	.03	.9	.1L	2.1	.2L	D169258
D169259	4.0	20	.05	1.0	.1	2.1	.5	D169259
D169260	10	20L	.03	.8	1.9	2.4	.2L	D169260
D169261	8.0	110	.09	3.7	.9	6.9	2.6	D169261
D169262	5.0	25	.03	.7	1.0	3.0L	.3	D169262

Table 13.--Major-, minor-, and trace-element composition of 34 coal samples from the Seldovia quadrangle, Alaska

[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; 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
D169228	5.9	3.3	1.2	0.15	0.16	0.59	0.56	0.15	25	30	D169228
D169229	2.3	1.4	1.0	.11	.069	.23	.40	.069	8.0	30	D169229
D169230	4.3	2.5	1.6	.12	.086	.42	.37	.12	10	30	D169230
D169231	1.7	1.1	1.1	.13	.041	.15	.31	.045	5.0	15	D169231
D169232	1.5	.84	1.2	.17	.033	.083	.83	.050	5.0	10	D169232
D169233	1.4	.74	1.0	.17	.039	.060	.45	.030	8.0	10	D169233
D169234	2.6	1.7	1.1	.096	.31	.29	.46	.059	10	50	D169234
D169236	2.7	1.7	1.2	.10	.34	.28	.42	.065	20	30	D169236
D169237	3.3	2.0	1.3	.10	.34	.36	.43	.081	15	30	D169237
D169238	3.5	2.0	1.4	.10	.17	.28	.49	.092	8.0	15	D169238
D169239	4.2	2.5	1.3	.12	.19	.39	.64	.10	8.0	20	D169239
D169240	1.6	.68	1.2	.079	.16	.13	.46	.033	8.0	20	D169240
D169241	.47	.34	1.0	.090	.28	.060	.29	.014	4.0	20	D169241
D169242	11	6.3	1.0	.41	.32	1.3	2.4	.25	20	30	D169242
D169243	2.4	1.3	1.2	.096	.062	.17	.42	.053	15	50	D169243
D169244	3.3	1.6	1.3	.11	.074	.30	.35	.098	8.0	20	D169244
D169245	.98	.52	1.0	.12	.047	.086	.73	.026	3.0	10	D169245
D169246	9.9	5.0	1.1	.34	.42	.78	1.7	.22	15	20	D169246
D169247	1.7	1.1	1.3	.13	.046	.10	.40	.052	10	15	D169247
D169248	1.1	.83	1.2	.13	.043	.066	.26	.027	8.0	15	D169248
D169249	3.1	1.4	1.1	.17	.088	.17	.84	.057	5.0	15	D169249
D169250	.78	.54	1.1	.17	.021	.038	.36	.028	2.0	10	D169250
D169251	1.4	.93	1.1	.15	.025	.059	.36	.049	4.0	10	D169251
D169252	2.7	1.1	1.0	.18	.078	.13	.54	.061	4.0	10	D169252
D169253	4.6	2.1	1.0	.21	.14	.25	.77	.12	8.0	15	D169253
D169254	2.0	.69	.99	.18	.062	.076	.84	.045	10	5	D169254
D169255	1.0	.50	1.1	.17	.026	.032	.61	.026	3.0	5	D169255
D169256	1.7	.96	1.2	.22	.044	.099	.59	.048	5.0	5	D169256
D169257	6.2	2.9	1.1	.25	.15	.46	.63	.15	8.0	20	D169257
D169258	.48	.31	1.3	.072	.22	.043	.87	.015	3.0	70	D169258
D169259	.83	.75	1.3	.072	.080	.071	.37	.035	4.0	50	D169259
D169260	8.8	4.2	1.1	.16	.47	.66	1.0	.21	10	20	D169260
D169261	.66	.55	1.2	.061	.24	.049	.41	.027	8.0	30	D169261
D169262	.85	.64	1.3	.066	.11	.078	.43	.031	5.0	50	D169262

Table 13.--Major-, minor-, and trace-element composition of 34 coal samples from the Seldovia quadrangle, Alaska--Continued

Sample number	Ba-S (ppm)	Be-S (ppm)	Co-S (ppm)	Cr-S (ppm)	Cu (ppm)	F (ppm)	Ga-S (ppm)	Ge-S (ppm)	Hg (ppm)	La-S (ppm)	Sample number
D169228	700	0.7	3	30	46	130	7	N	0.16	N	D169228
D169229	200	.7	7	20	18	60	2	3	.08	N	D169229
D169230	500	N	5	30	25	95	7	N	.13	N	D169230
D169231	500	.3	5	15	21	60	2	N	.08	7	D169231
D169232	500	.3	5	15	15	50	2	2L	.08	N	D169232
D169233	500	.3	3	10	15	45	1.5	2L	.08	7	D169233
D169234	700	.5	10	20	17	70	5	N	.06	N	D169234
D169236	500	.5	5	15	18	75	3	N	.08	N	D169236
D169237	500	.5	5	20	22	135	5	N	.09	N	D169237
D169238	1,000	1	5	20	36	90	5	N	.11	15	D169238
D169239	700	.7	7	30	41	100	7	N	.14	N	D169239
D169240	300	.3	7	10	10	35	2	2L	.04	N	D169240
D169241	500	.2	5	7	11	40	1	1L	.05	5	D169241
D169242	1,000	1.5	7	70	55	290	15	N	.40	N	D169242
D169243	500	.5	5	15	18	70	5	N	.06	N	D169243
D169244	300	.5	3	20	15	100	5	10	.08	N	D169244
D169245	200	N	2	7	18	50	1	N	.07	N	D169245
D169246	700	1.5	15	70	86	250	7	N	.23	30	D169246
D169247	700	N	3	10	25	75	1.5	N	.11	7	D169247
D169248	700	.2	5	7	11	20	1.5	N	.05	7	D169248
D169249	500	N	5	15	16	40	3	N	.07	N	D169249
D169250	200	N	2	3	7.5	30	1	2	.05	N	D169250
D169251	300	.7	3	15	13	30	1.5	N	.07	7	D169251
D169252	300	.5	5	15	12	65	3	N	.08	10	D169252
D169253	300	.7	5	30	26	65	7	5L	.14	N	D169253
D169254	150	.3	5	7	15	25	2	2L	.05	N	D169254
D169255	500	N	5	2	7.1	25	1.5	N	.03	N	D169255
D169256	500	.3	5	10	14	30	3	2L	.07	N	D169256
D169257	500	.7	3	30	29	105	7	N	.09	N	D169257
D169258	300	.2	7	5	7.2	20L	B	2	.03	N	D169258
D169259	500	.2	5	7	16	20	2	N	.05	5	D169259
D169260	700	1	7	50	70	20L	10	N	.03	N	D169260
D169261	700	.2	7	7	14	110	1.5	1.5L	.09	N	D169261
D169262	500	N	5	7	16	25	1.5	N	.03	N	D169262

Table 13.--Major-, minor-, and trace-element composition of 34 coal samples from the Seldovia quadrangle, Alaska--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
D169228	18	130	1.5	5L	15	1,300	7.6	1.2	7	0.3	D169228
D169229	4.2	62	1.5	2L	7	340	3.1	1.8	3	.2	D169229
D169230	12	60	1.5	5L	7	88L	7.0	1.6	5	.3	D169230
D169231	2.9	53	1	2L	7	780	3.2	1.1	2	.2	D169231
D169232	1.7	110	1	2L	7	870	2.7	.7	3	.1L	D169232
D169233	1.1	140	1	2L	7	800	2.3	.9	3	.2	D169233
D169234	4.2	42	7	3L	10	150	4.2	.8	3	.2	D169234
D169236	5.3	100	1.5	3L	7	680	3.7L	1.4	3	1.6	D169236
D169237	6.2	120	1.5	3L	10	740	6.0	1.4	3	.3	D169237
D169238	7.0	120	1.5	3L	15	680	6.1	1.4	5	.3	D169238
D169239	10	100	15	5	15	190	7.0	1.3	7	.3	D169239
D169240	3.2	48	1.5	2L	7	42L	2.4L	.5	1.5	.2	D169240
D169241	.6	42	1	N	7	26L	1.5	.3	1	.1L	D169241
D169242	9.8	250	N	10L	15	990	12L	2.1	15	1.3	D169242
D169243	3.9	130	2	N	10	470	3.2	.8	5	.2	D169243
D169244	3.9	45	1	3	5	160	3.8L	1.2	5	1.3	D169244
D169245	2.0	77	2	1.5L	5	34L	1.9L	.9	1.5	.2	D169245
D169246	26	120	3	7L	20	230	10L	3.4	15	1.4	D169246
D169247	2.6	55	1.5	N	5	1,000	3.3	1.0	3	1.4	D169247
D169248	1.2	61	2	1.5L	10	1,200	2.2L	.9	2	1.2	D169248
D169249	4.8	150	1	3L	10	530	3.8L	.9	5	1.7	D169249
D169250	1.0	110	.5	1.5L	5	540	1.8L	.4	1	1.3	D169250
D169251	3.1	90	1.5	2L	10	650	2.3L	.6	5	.1L	D169251
D169252	3.2	130	1L	3L	7	59L	3.4L	.6	5	2.0	D169252
D169253	9.6	100	1.5	5	10	88	5.0	1.2	7	.1L	D169253
D169254	2.0	160	1.5	2	7	150	2.7L	1.3	3	2.1	D169254
D169255	.9	120	1	N	5	830	2.0L	.2	1	.1L	D169255
D169256	2.0	170	1	2	5	860	2.8L	.8	3	1.8	D169256
D169257	21	130	N	5	15	390	6.4	1.2	7	1.8	D169257
D169258	1.6	150	1	1.5	7	32L	2.2	.9	2	.1L	D169258
D169259	1.8	40	1	1.5L	5	780	2.4	1.0	2	.1	D169259
D169260	24	110	2	7L	15	150L	11	.8	10	1.9	D169260
D169261	1.0	52	2	1.5L	10	500	1.9	3.7	2	.9	D169261
D169262	1.6	55	1	1.5L	7	390	2.0	.7	1.5	1.0	D169262

Table 13.--Major-, minor-, and trace-element composition of 34 coal samples from the Seldovia quadrangle, Alaska--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
D169228	300	3.5	1.3	70	7	0.7	15	30	D169228
D169229	200	3.0L	.6	100	3	.3	4.3	20	D169229
D169230	200	2.7	1.1	50	5	.5	5.8	30	D169230
D169231	200	3.0L	.6	30	3	.3	5.0	15	D169231
D169232	300	3.0L	.3	50	3	.5	3.2	15	D169232
D169233	300	2.4	.8	30	3	.3	3.4	15	D169233
D169234	500	2.2	.6	50	3	.5	11	20	D169234
D169236	300	3.0L	.7	30	3	.5	7.4	15	D169236
D169237	300	3.0L	.8	50	5	.5	9.7	15	D169237
D169238	300	2.9	1.1	100	10	1	11	20	D169238
D169239	300	3.6	1.3	100	7	.7	14	50	D169239
D169240	200	1.9	.2L	15	3	.3	7.4	10	D169240
D169241	200	3.0L	.3	10	5	.5	2.1	7	D169241
D169242	300	6.1	1.9	100	10	1.5	110	70	D169242
D169243	200	3.0L	.5	20	5	.5	4.5	15	D169243
D169244	150	3.0L	.7	70	5	.5	3.0	30	D169244
D169245	100	3.0L	.3	20	2	.2	8.2	7	D169245
D169246	200	3.5	3.1	200	20	2	81	70	D169246
D169247	300	3.0L	.6	30	5	.3	6.1	15	D169247
D169248	200	2.7	.3	20	7	.7	3.3	10	D169248
D169249	200	2.3	.7	30	5	.5	13	15	D169249
D169250	200	1.9	.2L	10	2	.2	3.4	7	D169250
D169251	200	2.5	.3	50	7	.7	3.4	15	D169251
D169252	100	2.8	.2L	70	7	.7	7.9	30	D169252
D169253	100	4.0	.4	150	7	.7	8.8	70	D169253
D169254	100	2.3	.2L	70	3	.5	5.7	20	D169254
D169255	200	3.2	.2L	10	2	.2	3.6	7	D169255
D169256	200	1.9	.4	20	3	.3	4.6	15	D169256
D169257	150	3.4	1.0	70	7	.7	14	30	D169257
D169258	200	2.1	.2L	15	3	.3	3.7	10	D169258
D169259	500	2.1	.5	20	5	.5	4.6	10	D169259
D169260	200	2.4	.2L	100	10	1.5	28	50	D169260
D169261	500	6.9	2.6	20	5	.5	3.0	10	D169261
D169262	200	3.0L	.3	20	5	.5	4.1	7	D169262

Table 14.--Proximate and ultimate analyses and heat-of-combustion, forms-of-sulfur, free-swelling-index and ash-fusion-temperature determinations for 24 coal samples from the Utukok River quadrangle, Alaska

[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, R, 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
D184598	8.7	32.5	55.3	3.5	5.3	71.2	1.5	18.2	0.3	6,820	12,280
	---	35.6	60.6	3.8	4.7	78.0	1.6	11.5	.3	7,470	13,450
	---	37.0	63.0	---	4.9	81.1	1.7	11.9	.3	7,770	13,990
D184599	25.5	31.5	38.4	4.6	5.8	51.2	1.4	36.8	.2	4,630	8,330
	---	42.3	51.5	6.2	4.0	68.7	1.9	19.0	.3	6,210	11,180
	---	45.1	54.9	---	4.2	73.2	2.0	20.2	.3	6,620	11,920
D184600	22.6	28.5	46.0	2.9	5.7	55.6	1.5	34.1	.2	5,110	9,200
	---	36.8	59.4	3.7	4.1	71.8	1.9	18.1	.3	6,600	11,890
	---	38.3	61.7	---	4.3	74.6	2.0	18.8	.3	6,860	12,350
D184601	13.9	30.2	52.8	3.1	5.3	63.6	1.3	26.4	.3	5,920	10,650
	---	35.1	61.3	3.6	4.4	73.9	1.5	16.3	.3	6,870	12,370
	---	36.4	63.6	---	4.5	76.6	1.6	16.9	.4	7,130	12,830
D184602	20.9	29.0	46.3	3.8	5.6	56.2	1.2	33.0	.2	5,170	9,310
	---	36.7	58.5	4.8	4.1	71.0	1.5	18.2	.3	6,540	11,770
	---	38.5	61.5	---	4.4	74.6	1.6	19.2	.3	6,870	12,360
D184603	18.9	28.1	48.5	4.5	5.4	58.8	1.2	29.7	.4	5,440	9,790
	---	34.6	59.8	5.5	4.1	72.5	1.5	15.9	.5	6,710	12,070
	---	36.7	63.3	---	4.3	76.8	1.6	16.8	.5	7,100	12,780
D184604	5.2	32.7	47.2	14.9	4.9	65.7	1.0	13.2	.3	6,340	11,410
	---	34.5	49.8	15.7	4.6	69.3	1.1	9.0	.3	6,690	12,040
	---	40.9	59.1	---	5.4	82.2	1.3	10.7	.4	7,930	14,280
D184605	9.7	27.8	46.9	15.6	4.8	59.6	1.0	18.8	.2	5,660	10,180
	---	30.8	51.9	17.3	4.1	66.0	1.1	11.3	.2	6,260	11,270
	---	37.2	62.8	---	5.0	79.8	1.3	13.6	.3	7,570	13,630
D184606	6.5	35.2	52.4	5.9	5.4	71.9	1.2	15.4	.2	7,030	12,660
	---	37.6	56.0	6.3	5.0	76.9	1.3	10.3	.2	7,520	13,540
	---	40.2	59.8	---	5.3	82.1	1.4	11.0	.2	8,030	14,450
D184607	6.7	38.1	51.9	3.3	5.4	72.5	1.5	17.1	.2	7,030	12,650
	---	40.8	55.6	3.5	5.0	77.7	1.6	11.9	.2	7,530	13,560
	---	42.3	57.7	---	5.2	80.6	1.7	12.4	.2	7,810	14,060
D184608	12.1	31.3	51.8	4.8	5.3	63.9	1.5	24.3	.2	6,030	10,850
	---	35.6	58.9	5.5	4.5	72.7	1.7	15.4	.2	6,860	12,340
	---	37.7	62.3	---	4.8	76.9	1.8	16.3	.2	7,250	13,060

Table 14.--Proximate and ultimate analyses and heat-of-combustion, forms-of-sulfur, free-swelling-index and ash-fusion-temperature determinations for 24 coal samples from the Utukok River quadrangle, Alaska--Continued

Sample number	Air-dried loss	Forms of sulfur			Free swelling index	Ash fusion temperature, °C		
		Sulfate	Pyritic	Organic		Initial deformation	Softening	Fluid
D184598	B	B	B	B	0.5	1,230	1,260	1,315
	---	B	B	B				
	---	B	B	B				
D184599	B	B	B	B	B	1,220	1,250	1,275
	---	B	B	B				
	---	B	B	B				
D184600	B	B	B	B	B	1,175	1,195	1,210
	---	B	B	B				
	---	B	B	B				
D184601	B	B	B	B	B	1,205	1,230	1,260
	---	B	B	B				
	---	B	B	B				
D184602	B	B	B	B	B	1,260	1,290	1,350
	---	B	B	B				
	---	B	B	B				
D184603	B	B	B	B	B	1,170	1,200	1,255
	---	B	B	B				
	---	B	B	B				
D184604	B	B	B	B	.50	1,305	1,330	1,360
	---	B	B	B				
	---	B	B	B				
D184605	B	B	B	B	B	1,295	1,320	1,350
	---	B	B	B				
	---	B	B	B				
D184606	B	B	B	B	2.0	1,140	1,170	1,200
	---	B	B	B				
	---	B	B	B				
D184607	B	B	B	B	.50	1,200	1,230	1,260
	---	B	B	B				
	---	B	B	B				
D184608	B	B	B	B	B	1,140	1,165	1,195
	---	B	B	B				
	---	B	B	B				

Table 14.--Proximate and ultimate analyses and heat-of-combustion, forms-of-sulfur, free-swelling-index and ash-fusion-temperature determinations for 24 coal samples from the Utukok River quadrangle, Alaska--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
D184609	12.8	31.7	48.2	7.3	5.2	60.4	1.8	25.1	0.2	5,650	10,170
	---	36.4	55.3	8.4	4.3	69.3	2.1	15.7	.2	6,480	11,660
	---	39.7	60.3	---	4.7	75.6	2.3	17.2	.3	7,070	12,730
D184610	6.1	35.1	51.8	7.0	5.4	70.8	1.8	14.8	.2	6,920	12,460
	---	37.4	55.2	7.5	5.0	75.4	1.9	10.0	.2	7,370	13,270
	---	40.4	59.6	---	5.4	81.5	2.1	10.8	.2	7,970	14,340
D184611	5.7	40.0	38.6	15.7	4.8	50.7	1.4	27.2	.2	4,660	8,390
	---	42.4	40.9	16.6	4.4	53.8	1.5	23.5	.2	4,940	8,900
	---	50.9	49.1	---	5.3	64.5	1.8	28.2	.3	5,930	10,670
D184612	6.5	35.0	52.7	5.8	5.5	71.8	1.5	15.1	.3	7,010	12,620
	---	37.4	56.4	6.2	5.1	76.8	1.6	10.0	.3	7,500	13,500
	---	39.9	60.1	---	5.4	81.9	1.7	10.6	.3	7,990	14,390
D184613	11.9	30.0	55.8	2.3	5.4	67.7	1.6	22.7	.3	6,400	11,520
	---	34.1	63.3	2.6	4.6	76.8	1.8	13.8	.3	7,260	13,080
	---	35.0	65.0	---	4.8	78.9	1.9	14.1	.3	7,460	13,430
D184614	8.4	34.3	52.9	4.4	5.4	71.0	1.4	17.5	.3	6,860	12,350
	---	37.4	57.8	4.8	4.9	77.5	1.5	11.0	.3	7,490	13,480
	---	39.3	60.7	---	5.1	81.4	1.6	11.5	.3	7,870	14,160
D184615	5.0	25.0	32.8	37.2	4.0	46.1	1.0	11.3	.4	4,530	8,150
	---	26.3	34.5	39.2	3.6	48.5	1.1	7.2	.4	4,770	8,580
	---	43.3	56.7	---	6.0	79.8	1.7	11.9	.7	7,830	14,100
D184616	14.1	30.9	52.6	2.4	5.3	63.0	1.4	27.6	.3	5,860	10,540
	---	36.0	61.2	2.8	4.3	73.3	1.6	17.5	.3	6,820	12,270
	---	37.0	63.0	---	4.5	75.4	1.7	18.0	.4	7,010	12,620
D203122	7.6	35.5	45.7	11.2	B	B	B	B	.2	5,430	9,770
	---	38.4	49.5	12.1	B	B	B	B	.2	5,870	10,570
	---	43.7	56.3	---	B	B	B	B	.2	6,680	12,030
D203123	6.3	27.4	35.2	31.1	B	B	B	B	.3	4,500	8,100
	---	29.2	37.6	33.2	B	B	B	B	.3	4,800	8,640
	---	43.8	56.2	---	B	B	B	B	.5	7,190	12,940
D203124	3.0	34.6	50.1	12.3	B	B	B	B	.5	6,680	12,020
	---	35.7	51.6	12.7	B	B	B	B	.5	6,880	12,390
	---	40.9	59.1	---	B	B	B	B	.6	7,880	14,190
D203125	1.8	31.8	45.5	20.9	B	B	B	B	.2	6,210	11,180
	---	32.4	46.3	21.3	B	B	B	B	.2	6,330	11,390
	---	41.1	58.9	---	B	B	B	B	.3	8,040	14,470

Table 14.--Proximate and ultimate analyses and heat-of-combustion, forms-of-sulfur, free-swelling-index and ash-fusion-temperature determinations for 24 coal samples from the Utukok River quadrangle, Alaska--Continued

Sample number	Air-dried loss	Forms of sulfur			Free swelling index	Ash fusion temperature, °C		
		Sulfate	Pyritic	Organic		Initial deformation	Softening	Fluid
D184609	B	B	B	B	B	1,230	1,260	1,315
	---	B	B	B				
	---	B	B	B				
D184610	B	B	B	B	1.5	1,260	1,290	1,350
	---	B	B	B				
	---	B	B	B				
D184611	B	B	B	B	B	1,350	1,405	1,460
	---	B	B	B				
	---	B	B	B				
D184612	B	B	B	B	2.0	1,165	1,200	1,250
	---	B	B	B				
	---	B	B	B				
D184613	B	B	B	B	B	1,170	1,200	1,255
	---	B	B	B				
	---	B	B	B				
D184614	B	B	B	B	.50	1,290	1,320	1,360
	---	B	B	B				
	---	B	B	B				
D184615	B	B	B	B	B	1,600	1,600	1,600
	---	B	B	B				
	---	B	B	B				
D184616	B	B	B	B	B	1,140	1,165	1,195
	---	B	B	B				
	---	B	B	B				
D203122	2.3	B	B	B	B	B	B	B
	---	B	B	B				
	---	B	B	B				
D203123	2.3	B	B	B	B	B	B	B
	---	B	B	B				
	---	B	B	B				
D203124	.9	B	B	B	B	B	B	B
	---	B	B	B				
	---	B	B	B				
D203125	.2	B	B	B	B	B	B	B
	---	B	B	B				
	---	B	B	B				

Table 14.--Proximate and ultimate analyses and heat-of-combustion, forms-of-sulfur, free-swelling-index and ash-fusion-temperature determinations for 24 coal samples from the Utukok River quadrangle, Alaska--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
D203126	2.0	35.2	58.6	4.2	B	B	B	B	0.2	7,680	13,820
	---	35.9	59.8	4.3	B	B	B	B	.2	7,830	14,100
	---	37.5	62.5	---	B	B	B	B	.2	8,180	14,730

Sample number	Air-dried loss	Forms of sulfur			Free swelling index	Ash fusion temperature, °C		
		Sulfate	Pyritic	Organic		Initial deformation	Softening	Fluid
D203126	B	B	B	B	B	B	B	B
	---	B	B	B				
	---	B	B	B				

Table 15.--Major- and minor-oxide and trace element composition of the laboratory ash of 54 coal samples from the Utukok River quadrangle, Alaska

[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
D184598	3.8	28	28	13	1.70	1.05	0.75	7.0	2.2	3.7	D184598
D184599	8.0	5.9	8.4	38	3.45	1.41	1.1	4.7	.84	1.0L	D184599
D184600	3.5	9.4	14	30	5.23	4.40	1.2	12	1.4	1.0L	D184600
D184601	3.2	27	25	9.7	2.63	.93	2.3	11	2.1	1.4	D184601
D184602	5.4	14	15	32	5.20	4.00	1.6	8.8	1.1	1.0L	D184602
D184603	5.5	20	22	15	3.10	1.83	1.5	16	1.8	6.2	D184603
D184604	15.8	38	28	9.7	2.65	.45	.73	2.7	5.5	3.2	D184604
D184605	15.1	53	22	4.5	1.81	.65	2.8	5.3	1.3	1.0L	D184605
D184606	6.1	42	19	8.8	3.25	2.11	1.1	7.0	2.6	2.0	D184606
D184607	3.9	15	21	20	7.93	4.58	.60	6.2	4.3	3.3	D184607
D184608	5.1	25	22	15	5.33	7.10	1.9	4.7	1.4	1.8	D184608
D184609	8.3	38	26	6.6	2.85	4.30	.78	4.2	5.3	1.0L	D184609
D184610	7.6	32	22	14	3.63	.51	.69	6.4	5.6	2.5	D184610
D184611	16.4	53	22	5.3	2.73	.56	3.4	2.5	1.3	2.1	D184611
D184612	6.3	32	21	12	3.75	1.19	1.8	11	1.3	1.6	D184612
D184613	2.4	28	22	6.7	3.08	2.00	1.0	18	1.5	1.1	D184613
D184614	4.4	33	26	10	1.72	.54	1.0	7.0	2.0	7.0	D184614
D184615	38.9	61	22	1.0	1.42	.51	4.2	1.8	1.3	1.0L	D184615
D184616	3.0	36	8.9	14	3.63	1.78	.57	13	.93	1.0L	D184616
D203122	5.0	B	B	B	B	B	B	B	B	B	D203122
D203123	31.7	B	B	B	B	B	B	B	B	B	D203123
D203124	12.8	B	B	B	B	B	B	B	B	B	D203124
D203125	24.3	B	B	B	B	B	B	B	B	B	D203125
D203126	4.3	B	B	B	B	B	B	B	B	B	D203126
D213965	4.2	32	17	12	6.13	1.48	1.0	8.0	.75	.71	D213965
D213966	5.1	26	19	9.1	3.81	4.04	.92	11	1.1	2.4	D213966
D213967	11.0	49	25	5.5	1.99	1.89	2.2	3.4	.89	.82	D213967
D213968	4.6	28	19	14	4.15	2.83	1.1	8.4	.68	1.7	D213968
D213969	10.9	51	25	2.8	2.49	.93	2.4	5.4	1.1	.64	D213969
D213970	11.6	45	18	6.4	3.98	1.75	1.3	5.6	.97	2.8	D213970
D213971	20.2	56	26	2.7	1.41	1.13	2.2	2.6	1.4	.74	D213971
D213972	11.8	41	30	5.6	2.65	1.08	1.6	6.0	.92	2.4	D213972
D213973	9.5	41	23	7.7	2.82	2.16	1.6	5.9	.90	1.9	D213973
D213974	8.2	41	23	7.7	2.98	1.01	1.6	5.9	.90	2.2	D213974
D213975	11.1	30	19	9.7	4.81	.77	1.2	17	1.0	.72	D213975
D213976	9.5	39	25	7.7	4.81	2.56	1.8	3.7	1.5	1.1	D213976
D213977	9.3	32	23	9.8	4.97	3.50	1.2	4.7	2.5	.86	D213977
D213978	15.4	43	25	4.2	2.49	1.28	1.8	8.0	3.0	.52	D213978
D213979	4.4	30	21	9.1	5.14	5.12	.84	5.7	2.3	1.8	D213979

Table 15.--Major- and minor-oxide and trace element composition of the laboratory ash of 54 coal samples from the Utukok River quadrangle, Alaska--Continued

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
D184598	8.6	1,000	20,000	7	1.0	500L	70	50	79	50	D184598
D184599	1.1	300	10,000	30	1.5	700	70	15	36	15	D184599
D184600	17	1,500	15,000	3L	1.0	500L	30	30	77	30	D184600
D184601	11	1,500	20,000	7	1.5	500	70	150	85	30	D184601
D184602	9.0	700	15,000	5	1.0	N	30	30	69	20	D184602
D184603	9.7	700	20,000	7	1.0L	500L	70	70	85	30	D184603
D184604	1.6	200	7,000	7	1.5	N	70	50	150	70	D184604
D184605	2.7	700	3,000	7	1.0L	500L	30	150	75	30	D184605
D184606	5.2	700	10,000	7	1.0	500L	70	70	77	30	D184606
D184607	8.4	2,000	15,000	7	1.0L	500L	70	100	263	30	D184607
D184608	8.3	1,500	15,000	7	1.0	500L	20	100	116	30	D184608
D184609	4.4	700	7,000	15	1.0L	500L	70	70	179	50	D184609
D184610	3.9	700	15,000	7	2.0	500	70	70	161	50	D184610
D184611	2.7	300	7,000	7	1.0L	500L	30	150	79	30	D184611
D184612	4.3	1,000	10,000	7	1.0	500L	30	100	116	30	D184612
D184613	9.0	1,500	10,000	5	1.0L	500L	70	50	66	30	D184613
D184614	4.7	700	20,000	10	1.0L	500L	150	50	74	50	D184614
D184615	.34	150	1,500	7	1.5	7	150	150	72	30	D184615
D184616	17	1,000	10,000	5	1.0	N	100	30	54	15	D184616
D203122	B	500	7,000	7	B	500L	30	50	B	70	D203122
D203123	B	200	1,000	3	B	N	30	100	B	30	D203123
D203124	B	300	3,000	5	B	N	30	100	B	50	D203124
D203125	B	100	3,000	3	B	N	30	150	B	30	D203125
D203126	B	700	5,000	7	B	500L	70	500	B	30	D203126
D213965	B	1,500	15,000	N	4.0	N	20	100	54	30	D213965
D213966	B	1,500	15,000	3L	5.0	N	100	100	74	30	D213966
D213967	B	1,000	1,000	3L	4.0	N	50	150	34	50	D213967
D213968	B	2,000	20,000	3L	3.0	N	20	70	39	50	D213968
D213969	B	500	3,000	3	3.0	N	30	150	52	50	D213969
D213970	B	500	10,000	3	3.0	N	70	200	62	50	D213970
D213971	B	200	2,000	3	3.0	N	50	150	53	70	D213971
D213972	B	500	7,000	10	3.0	N	50	100	50	70	D213972
D213973	B	500	10,000	3L	4.0	N	50	100	47	50	D213973
D213974	B	1,000	10,000	3L	4.0	N	50	100	35	30	D213974
D213975	B	700	7,000	7	3.0	N	30	100	41	50	D213975
D213976	B	500	7,000	5	1.0L	N	20	100	59	50	D213976
D213977	B	700	10,000	5	1.0	N	20	100	71	50	D213977
D213978	B	500	5,000	5	2.0	N	50	150	75	50	D213978
D213979	B	2,000	15,000	3L	1.0	N	30	150	155	50	D213979
D213980	B	1,000	10,000	3L	3.0	N	200	70	58	B	D213980

Table 15.--Major- and minor-oxide and trace element composition of the laboratory ash of 54 coal samples from the Utukok River quadrangle, Alaska--Continued

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
D184598	20L	150	365	170	7	50	150	150	45	30	D184598
D184599	N	500	53	60	15	100	150	70	70	30	D184599
D184600	N	100L	122	300	7	30	N	100	35	20	D184600
D184601	N	300	159	425	N	30	150	300	30	30	D184601
D184602	N	100L	164	180	7	20	N	70	30	20	D184602
D184603	N	150	195	1,060	N	30	150L	300	50	30	D184603
D184604	N	150	227	140	N	70	150	150	85	50	D184604
D184605	N	100	203	245	N	50	150L	70	25L	30	D184605
D184606	N	150	167	360	N	70	150	150	40	30	D184606
D184607	N	150	113	200	N	50	150	50	30	70	D184607
D184608	20	100	119	115	10	30	150L	150	50	30	D184608
D184609	N	150	216	130	7	70	150	200	75	70	D184609
D184610	20L	150	182	190	10	70	200	200	50	20	D184610
D184611	N	100	125	50	7	30	150	70	50	30	D184611
D184612	20L	100L	175	765	10	30	150L	70	60	30	D184612
D184613	N	100L	319	510	N	30	N	200	50L	20	D184613
D184614	N	150	301	210	15	70	150L	300	50	30	D184614
D184615	N	N	216	60	N	30	150L	70	55	N	D184615
D184616	N	N	72	190	N	30	B	150	25L	10	D184616
D203122	N	150	B	B	N	30	150	50	B	50	D203122
D203123	N	N	B	B	7L	20L	B	30	B	15	D203123
D203124	30	N	B	B	7L	20L	B	100	B	15	D203124
D203125	N	70	B	B	N	20L	N	100	B	30	D203125
D203126	N	70	B	B	7L	20L	150	500	B	20	D203126
D213965	N	N	107	272	N	20L	B	50	30	20	D213965
D213966	N	100L	157	637	N	20L	N	300	29	30	D213966
D213967	N	100L	186	113	N	20L	N	100	25L	20	D213967
D213968	N	100L	121	326	N	20L	N	100	57	20	D213968
D213969	N	100L	269	181	N	20L	N	100	32	20	D213969
D213970	N	100L	121	395	N	20L	N	200	26	20	D213970
D213971	N	100L	205	127	N	20L	N	70	25L	30	D213971
D213972	N	100L	138	258	N	20L	N	100	84	20	D213972
D213973	N	100L	186	350	N	20L	N	100	25L	15	D213973
D213974	N	100L	143	157	N	20L	N	200	25L	20	D213974
D213975	N	100L	120	1,540	N	20L	N	150	39	20	D213975
D213976	N	100L	143	146	N	20L	N	100	46	30	D213976
D213977	N	100L	144	229	N	20L	N	70	67	30	D213977
D213978	N	100	126	711	N	20L	150	100	46	50	D213978
D213979	N	100L	94	206	N	20L	N	150	26	50	D213979
D213980	N	N	79	1,850	N	20L	B	300	25L	10	D213980

Table 15.--Major- and minor-oxide and trace element composition of the laboratory ash of 54 coal samples from the Utukok River quadrangle, Alaska--Continued

Sample number	Sr-S (ppm)	V-S (ppm)	Y-S (ppm)	Yb-S (ppm)	Zn (ppm)	Zr-S (ppm)	Sample number
D184598	7,000	70	150	15	60	300	D184598
D184599	3,000	70	100	7	68	1,500	D184599
D184600	2,000	70	70	7	76	200	D184600
D184601	5,000	300	100	7	315	200	D184601
D184602	2,000	100	100	10	88	150	D184602
D184603	5,000	150	100	7	135	150	D184603
D184604	2,000	500	150	15	279	300	D184604
D184605	700	300	70	7	101	200	D184605
D184606	2,000	300	150	10	131	300	D184606
D184607	3,000	500	100	7	96	500	D184607
D184608	2,000	300	70	7	137	150	D184608
D184609	1,000	700	150	15	415	500	D184609
D184610	3,000	700	200	15	238	500	D184610
D184611	2,000	300	70	7	67	200	D184611
D184612	2,000	300	70	7	181	150	D184612
D184613	1,500	100	70	7	313	200	D184613
D184614	7,000	150	150	10	94	300	D184614
D184615	300	300	70	7	125	200	D184615
D184616	700	70	50	3	100	70	D184616
D203122	2,000	500	70	7	B	500	D203122
D203123	700	150	30	3	B	200	D203123
D203124	1,000	150	30	5	B	300	D203124
D203125	1,000	200	30	3	B	200	D203125
D203126	1,000	150	50	5	B	500	D203126
D213965	1,500	150	50	5	73	200	D213965
D213966	3,000	200	50	5	118	500	D213966
D213967	3,000	200	50	7	68	300	D213967
D213968	5,000	150	50	5	76	200	D213968
D213969	1,500	300	50	5	128	500	D213969
D213970	5,000	300	50	5	106	300	D213970
D213971	1,000	300	50	7	69	500	D213971
D213972	2,000	200	70	7	54	500	D213972
D213973	5,000	150	50	5	108	500	D213973
D213974	5,000	150	50	5	99	300	D213974
D213975	1,000	200	50	5	147	200	D213975
D213976	2,000	300	50	7	110	300	D213976
D213977	1,500	300	70	7	131	500	D213977
D213978	2,000	500	70	10	102	500	D213978
D213979	2,000	500	50	5	92	300	D213979
D213980	2,000	100	20	3	100	150	D213980

Table 15.--Major- and minor-oxide and trace element composition of the laboratory ash of 54 coal samples from the Utukok River quadrangle, Alaska--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
D213981	5.3	30	16	7.3	4.48	0.73	1.2	17	0.78	0.94	D213981
D213982	5.3	32	19	7.3	2.82	2.29	1.1	17	.73	2.3	D213982
D213944	7.6	28	21	13	5.64	.88	.34	5.7	.50	1.3	D213944
D213945	36.8	58	23	.80	2.16	.89	3.6	3.9	1.1	.050	D213945
D213946	3.3	4.1	11	17	12.1	4.72	.12	12	.32	.30L	D213946
D213947	5.5	36	25	5.6	3.65	4.18	1.4	5.0	1.2	2.9	D213947
D213948	9.2	43	21	8.0	4.97	1.04	1.4	4.2	1.4	2.4	D213948
D213949	2.1	3.9	11	20	11.1	5.80	.26	10	.35	.48L	D213949
D213950	5.6	28	26	7.4	4.81	6.47	.60	4.0	.25	1.4	D213950
D213951	12.9	34	26	6.2	2.16	1.48	2.4	3.9	2.3	4.2	D213951
D213952	6.7	19	21	13	4.64	2.56	1.6	6.0	.57	5.4	D213952
D213953	6.1	41	36	3.6	1.04	1.32	.43	3.4	.77	.16L	D213953
D213954	4.4	17	26	5.0	1.66	.92	.77	12	.80	8.9	D213954
D213955	2.0	32	28	2.5	1.99	2.16	1.4	11	1.1	1.5	D213955

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
D213981	B	1,000	15,000	3L	2.0	N	70	100	55	30	D213981
D213982	B	1,000	15,000	5	1.0	N	30	100	56	30	D213982
D213944	B	500	10,000	3	1.0L	N	100	70	49	50	D213944
D213945	B	100	2,000	3L	1.0L	N	20	300	87	50	D213945
D213946	B	2,000	15,000	3L	1.0L	B	50	70	43	15	D213946
D213947	B	1,000	15,000	3	1.0L	500L	100	150	83	50	D213947
D213948	B	300	5,000	3	1.0L	N	100	300	82	50	D213948
D213949	B	1,500	15,000	N	1.0L	B	50	70	47	15	D213949
D213950	B	1,500	15,000	5	1.0L	500L	30	50	41	10L	D213950
D213951	B	500	15,000	30	1.0L	700	100	70	100	50	D213951
D213952	B	1,000	30,000	3L	1.0L	N	70	50	38	30	D213952
D213953	B	700	5,000	3	1.0L	N	150	30	52	70	D213953
D213954	B	700	50,000	15	1.0L	N	70	150	72	70	D213954
D213955	B	3,000	7,000	7	1.0	N	150	150	97	70	D213955

Table 15.--Major- and minor-oxide and trace element composition of the laboratory ash of 54 coal samples from the Utukok River quadrangle, Alaska--Continued

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
D213981	N	N	22	1,100	N	20L	B	300	25L	15	D213981
D213982	N	N	117	1,060	N	20L	B	300	25L	15	D213982
D213944	N	100L	129	225	N	20L	N	300	57	70	D213944
D213945	N	100L	129	94	N	20L	N	100	25L	50	D213945
D213946	N	N	29	246	N	N	B	200	25L	20	D213946
D213947	N	200	127	120	N	20L	N	300	26	30	D213947
D213948	N	100L	149	120	N	20L	N	200	54	70	D213948
D213949	N	N	24	255	N	N	B	200	25L	15	D213949
D213950	N	200	141	89	10	20L	150	150	35	30	D213950
D213951	N	500	189	121	10	50	700	100	82	50	D213951
D213952	N	100	123	193	N	20L	N	300	25L	20	D213952
D213953	N	N	315	30L	7L	20L	B	200	38	20	D213953
D213954	30	100	173	1,050	N	20L	N	200	39	50	D213954
D213955	N	100	530	251	7L	20L	N	300	64	50	D213955

Sample number	Sr-S (ppm)	V-S (ppm)	Y-S (ppm)	Yb-S (ppm)	Zn (ppm)	Zr-S (ppm)	Sample number
D213981	1,500	150	50	5	202	200	D213981
D213982	3,000	150	50	5	192	200	D213982
D213944	1,500	70	100	10	36	500	D213944
D213945	150	700	50	5	182	200	D213945
D213946	1,500	150	50	5	67	150	D213946
D213947	5,000	300	50	5	110	300	D213947
D213948	1,000	500	100	10	97	500	D213948
D213949	1,500	150	20	3	93	150	D213949
D213950	5,000	100	100	10	110	200	D213950
D213951	15,000	1,500	150	10	162	200	D213951
D213952	10,000	100	70	7	46	500	D213952
D213953	1,000	150	100	7	64	700	D213953
D213954	15,000	500	100	7	123	500	D213954
D213955	3,000	300	100	7	136	1,000	D213955

Table 16.--Contents of seven trace elements in 54 coal samples from the Utukok River quadrangle, Alaska

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

Sample number	As (ppm)	F (ppm)	Hg (ppm)	Sb (ppm)	Se (ppm)	Th (ppm)	U (ppm)	Sample number
D184598	2.4	65	0.03	0.1	0.5	1.2	0.6	D184598
D184599	2.4	65	.03	.3	.1L	6.7	3.2	D184599
D184600	1.2	20L	.02	.1L	.2	.5	.3	D184600
D184601	2.1	35	.04	.1L	.5	.8	.3	D184601
D184602	2.7	20L	.03	.1L	.3	.8	.5	D184602
D184603	1.4	95	.03	.2	.7	3.0	1.6	D184603
D184604	8.1	105	.20	.1L	.5	8.3	3.0	D184604
D184605	2.9	105	.03	.3	.6	3.0	1.0	D184605
D184606	3.1	50	.03	.1L	.3	1.9	.6	D184606
D184607	2.2	35	.03	.2	.5	1.5	.4	D184607
D184608	2.6	55	.04	.2	.3	2.7	1.3	D184608
D184609	.1L	35	.09	.1L	.9	4.6	2.5	D184609
D184610	3.7	130	.40	.1L	.2	2.7	1.8	D184610
D184611	2.5	250	.03	.3	.3	7.5	2.5	D184611
D184612	3.3	65	.06	.4	.6	2.3	1.2	D184612
D184613	1.7	20L	.05	.1L	.1	.8	.4	D184613
D184614	1.7	100	.04	.3	.2	1.3	.7	D184614
D184615	1.8	230	.11	.5	.4	7.1	2.4	D184615
D184616	2.6	20L	.03	.1L	.1	.6	.2L	D184616
D203122	B	B	B	B	B	3.0L	.2L	D203122
D203123	B	B	B	B	B	3.0L	.2L	D203123
D203124	B	B	B	B	B	3.0L	.2L	D203124
D203125	B	B	B	B	B	3.0L	.2L	D203125
D203126	B	B	B	B	B	3.0L	.2L	D203126
D213965	2.2	30	.17	.1L	.4	.6	.2	D213965
D213966	1.3	50	.03	.1	.3	1.3	.3	D213966
D213967	2.3	70	.04	.2	.1L	2.1	.7	D213967
D213968	1.3	40	.02	.1L	.3	.8	.3L	D213968
D213969	1.5	65	.07	.2	.6	3.8	1.5	D213969
D213970	2.8	95	.05	.2	.1L	3.6	1.5	D213970
D213971	2.0	120	.05	.4	1.0	3.4	4.5	D213971
D213972	4.1	85	.07	.5	.1L	14	4.0	D213972
D213973	2.7	55	.06	.2	.8	2.7	4.8	D213973
D213974	2.1	70	.03	.1	.6	1.8	4.6	D213974
D213975	4.1	45	.03	.3	.1L	6.1	4.5	D213975
D213976	2.4	55	.03	.3	.1L	5.4	4.8	D213976
D213977	3.6	35	.05	.2	.7	5.5	4.7	D213977
D213978	2.3	70	.10	.2	1.2	5.0	4.8	D213978
D213979	1.4	25	.07	.1	.3	1.5	4.6	D213979
D213980	1.3	20L	.04	.1	.3	.7	6.2	D213980

Table 16.--Contents of seven trace elements in 54 coal samples from the Utukok River quadrangle, Alaska

Sample number	As (ppm)	F (ppm)	Hg (ppm)	Sb (ppm)	Se (ppm)	Th (ppm)	U (ppm)	Sample number
D213981	1.8	30	0.06	0.1L	0.5	1.0	5.1	D213981
D213982	2.2	40	.07	.1	.4	2.1	6.1	D213982
D213944	2.0	45	.07	.1	.7	2.3	2.5	D213944
D213945	2.1	27	.06	.6	.8	5.8	1.9	D213945
D213946	.7	20L	.03	.1L	.5	.5	.8	D213946
D213947	1.5	40	.03	.1	.6	1.6	.9	D213947
D213948	2.0	55	.03	.2	.4	2.7	1.3	D213948
D213949	.8	20L	.03	.1L	.8	.3	.4	D213949
D213950	1.5	35	.03	.1	.7	.9	1.5	D213950
D213951	2.9	310	.04	.5	.1L	15	3.1	D213951
D213952	2.6	35	.05	.1	.7	.1L	.9	D213952
D213953	2.2	20	.08	.1	.4	1.8	.6	D213953
D213954	1.5	85	.05	.3	.5	4.2	1.3	D213954
D213955	1.4	25	.07	.1	.5	1.8	.4	D213955

Table 17.--Major-, minor-, and trace-element composition of 54 coal samples from the Utukok River quadrangle, Alaska

[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; 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
D184598	0.50	0.56	0.35	0.039	0.030	0.024	0.19	0.050	2.4	30	D184598
D184599	.22	.36	2.2	.17	.084	.073	.26	.040	2.4	20	D184599
D184600	.15	.26	.75	.11	.11	.035	.29	.029	1.2	50	D184600
D184601	.40	.42	.22	.051	.022	.061	.25	.040	2.1	50	D184601
D184602	.35	.43	1.2	.17	.16	.072	.33	.036	2.7	30	D184602
D184603	.51	.64	.59	.10	.075	.069	.62	.059	1.4	50	D184603
D184604	2.8	2.3	1.1	.25	.053	.096	.30	.52	8.1	30	D184604
D184605	3.7	1.8	.49	.16	.073	.35	.56	.12	2.9	100	D184605
D184606	1.2	.61	.38	.12	.095	.056	.30	.095	3.1	50	D184606
D184607	.27	.43	.56	.19	.13	.019	.17	.10	2.2	70	D184607
D184608	.60	.59	.55	.16	.27	.081	.17	.043	2.6	70	D184608
D184609	1.5	1.1	.39	.14	.26	.054	.24	.26	.1L	70	D184609
D184610	1.1	.88	.76	.17	.029	.044	.34	.25	3.7	50	D184610
D184611	4.1	1.9	.62	.27	.068	.46	.29	.13	2.5	50	D184611
D184612	.94	.70	.54	.14	.056	.094	.48	.049	3.3	70	D184612
D184613	.31	.28	.11	.045	.036	.020	.30	.022	1.7	30	D184613
D184614	.68	.61	.31	.046	.018	.037	.22	.053	1.7	30	D184614
D184615	11	4.5	.28	.33	.15	1.4	.49	.30	1.8	70	D184615
D184616	.50	.14	.30	.066	.040	.014	.27	.017	2.6	30	D184616
D203122	B	B	B	B	B	B	B	B	B	20	D203122
D203123	B	B	B	B	B	B	B	B	B	70	D203123
D203124	B	B	B	B	B	B	B	B	B	50	D203124
D203125	B	B	B	B	B	B	B	B	B	20	D203125
D203126	B	B	B	B	B	B	B	B	B	30	D203126
D213965	.63	.39	.37	.15	.046	.036	.24	.019	2.2	70	D213965
D213966	.61	.51	.33	.12	.15	.039	.41	.032	1.3	70	D213966
D213967	2.5	1.4	.43	.13	.15	.20	.26	.059	2.3	100	D213967
D213968	.60	.46	.45	.11	.096	.041	.27	.019	1.3	100	D213968
D213969	2.6	1.4	.22	.16	.075	.22	.41	.074	1.5	50	D213969
D213970	2.4	1.1	.53	.28	.15	.13	.45	.067	2.8	70	D213970
D213971	5.2	2.8	.38	.17	.17	.36	.36	.17	2.0	50	D213971
D213972	2.2	1.9	.47	.19	.094	.15	.50	.065	4.1	70	D213972
D213973	1.8	1.1	.52	.16	.15	.12	.39	.051	2.7	50	D213973
D213974	1.6	.98	.45	.15	.061	.11	.34	.044	2.1	70	D213974
D213975	1.6	1.1	.77	.32	.063	.11	1.3	.066	4.1	70	D213975
D213976	1.7	1.2	.52	.28	.18	.14	.25	.085	2.4	50	D213976
D213977	1.4	1.1	.65	.28	.24	.090	.31	.14	3.6	70	D213977
D213978	3.1	2.0	.46	.23	.15	.23	.86	.28	2.3	70	D213978
D213979	.62	.48	.29	.14	.17	.031	.18	.062	1.4	100	D213979
D213980	.32	.21	.16	.093	.015	.014	.90	.011	1.3	50	D213980

Table 17.--Major-, minor-, and trace-element composition of 54 coal samples from the Utukok River quadrangle, Alaska--Continued

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
D184598	700	0.3	0.04	20L	3	2	3.0	65	2	0.7L	D184598
D184599	700	2	.12	50	5	1	2.9	65	1	N	D184599
D184600	500	.1L	.04	15L	1	1	2.7	20L	1	N	D184600
D184601	700	.2	.05	15	2	5	2.7	35	1	N	D184601
D184602	700	.3	.05	N	1.5	1.5	3.7	20L	1	N	D184602
D184603	1,000	.5	.06L	30L	5	5	4.7	95	1.5	N	D184603
D184604	1,000	1	.24	N	10	7	24	105	10	N	D184604
D184605	500	1	.15L	70L	5	20	11	105	5	N	D184605
D184606	700	.5	.06	30L	5	5	4.7	50	2	N	D184606
D184607	700	.3	.04L	20L	3	5	10	35	1	N	D184607
D184608	700	.3	.05	20L	1	5	5.9	55	1.5	1	D184608
D184609	700	1.5	.08L	50L	7	7	15	35	5	N	D184609
D184610	1,000	.5	.15	30	5	5	12	130	3	1.5L	D184610
D184611	1,000	1	.16L	70L	5	20	13	250	5	N	D184611
D184612	700	.5	.06	30L	2	7	7.3	65	2	1.5L	D184612
D184613	200	.1	.02L	10L	1.5	1	1.6	20L	.7	N	D184613
D184614	1,000	.5	.04L	20L	7	2	3.3	100	2	N	D184614
D184615	700	3	.58	3	70	70	28	230	10	N	D184615
D184616	300	.15	.03	N	3	1	1.6	20L	.5	N	D184616
D203122	300	.3	B	20L	1.5	2	B	B	3	N	D203122
D203123	300	1	B	N	10	30	B	B	10	N	D203123
D203124	500	.7	B	N	5	15	B	B	7	5	D203124
D203125	700	.7	B	N	7	30	B	B	7	N	D203125
D203126	200	.3	B	20L	3	20	B	B	1.5	N	D203126
D213965	700	N	.17	N	1	5	2.3	30	1.5	N	D213965
D213966	700	.15L	.26	N	5	5	3.8	50	1.5	N	D213966
D213967	100	.3L	.44	N	5	15	3.7	70	5	N	D213967
D213968	1,000	.15L	.14	N	1	3	1.8	40	2	N	D213968
D213969	300	.3	.33	N	3	15	5.7	65	5	N	D213969
D213970	1,000	.3	.35	N	7	20	7.2	95	7	N	D213970
D213971	500	.7	.61	N	10	30	11	120	15	N	D213971
D213972	1,000	1	.35	N	7	10	5.9	85	10	N	D213972
D213973	1,000	.3L	.38	N	5	10	4.5	55	5	N	D213973
D213974	700	.2L	.33	N	5	7	2.9	70	2	N	D213974
D213975	700	.7	.33	N	3	10	4.6	45	5	N	D213975
D213976	700	.5	.10L	N	2	10	5.6	55	5	N	D213976
D213977	1,000	.5	.09	N	2	10	6.6	35	5	N	D213977
D213978	700	.7	.31	N	7	20	12	70	7	N	D213978
D213979	700	.15L	.04	N	1.5	7	6.8	25	2	N	D213979
D213980	500	.1L	.12	N	7	3	2.3	20L	B	N	D213980

Table 17.--Major-, minor-, and trace-element composition of 54 coal samples from the Utukok River quadrangle, Alaska--Continued

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
D184598	0.03	7	14	6.5	0.3	2	7	7	610	1.7	D184598
D184599	.03	50	4.2	4.8	1	7	10	5	350L	5.6	D184599
D184600	.02	3L	4.3	11	.2	1	N	3	150L	1.2	D184600
D184601	.04	10	5.1	14	N	1	5	10	200	1.0	D184601
D184602	.03	5L	8.9	9.7	.3	1	N	3	240L	1.6	D184602
D184603	.03	7	11	58	N	1.5	7L	15	1,500	2.8	D184603
D184604	.20	20	36	22	N	10	20	20	2,200	13	D184604
D184605	.03	15	31	37	N	7	20L	10	660L	3.8L	D184605
D184606	.03	10	10	22	N	5	10	10	530	2.4	D184606
D184607	.03	7	4.4	7.8	N	2	7	2	560	1.2	D184607
D184608	.04	5	6.1	5.9	.5	1.5	7L	7	400	2.6	D184608
D184609	.09	15	18	11	.7	7	15	15	360L	6.2	D184609
D184610	.40	10	14	14	.7	5	15	15	830	3.8	D184610
D184611	.03	15	21	8.2	1	5	20	10	1,500	8.2	D184611
D184612	.06	7L	11	48	.7	2	10L	5	440	3.8	D184612
D184613	.05	2L	7.7	12	N	.7	N	5	120	1.2L	D184613
D184614	.04	7	13	9.2	.7	3	7L	15	1,300	2.2	D184614
D184615	.11	N	84	23	N	10	70L	30	1,700L	21	D184615
D184616	.03	N	2.2	5.7	N	1	B	5	130L	.8L	D184616
D203122	B	7	B	B	N	1.5	7	2	B	B	D203122
D203123	B	N	B	B	2L	7L	B	10	B	B	D203123
D203124	B	N	B	B	1L	2L	B	15	B	B	D203124
D203125	B	15	B	B	N	5L	N	20	B	B	D203125
D203126	B	3	B	B	.3L	1L	7	20	B	B	D203126
D213965	.17	N	4.5	11	N	1L	B	2	130	1.3	D213965
D213966	.03	5L	8.0	32	N	1L	N	15	520	1.5	D213966
D213967	.04	10L	20	12	N	2L	N	10	390	2.8L	D213967
D213968	.02	5L	5.6	15	N	1L	N	5	350	2.6	D213968
D213969	.07	10L	29	20	N	2L	N	10	300	3.5	D213969
D213970	.05	10L	14	46	N	2L	N	20	1,400	3.0	D213970
D213971	.05	20L	41	26	N	5L	N	15	650	5.1L	D213971
D213972	.07	10L	16	30	N	2L	N	10	1,200	9.9	D213972
D213973	.06	10L	18	33	N	2L	N	10	780	2.4L	D213973
D213974	.03	7L	12	13	N	1.5L	N	15	790	2.1L	D213974
D213975	.03	10L	13	170	N	2L	N	15	350	4.3	D213975
D213976	.03	10L	14	14	N	2L	N	10	440	4.4	D213976
D213977	.05	10L	13	21	N	2L	N	7	350	6.2	D213977
D213978	.10	15	19	110	N	3L	20	15	350	7.1	D213978
D213979	.07	5L	4.1	9.1	N	1L	N	7	350	1.1	D213979
D213980	.04	N	3.1	72	N	.7L	B	10	130	1.0L	D213980

Table 17.--Major-, minor-, and trace-element composition of 54 coal samples from the Utukok River quadrangle, Alaska--Continued

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
D184598	0.1	1	0.5	300	1.2	0.6	3	7	0.7	2.3	D184598
D184599	.3	2	.1L	200	6.7	3.2	5	7	.5	5.4	D184599
D184600	.1L	.7	.2	70	.5	.3	2	2	.2	2.7	D184600
D184601	.1L	1	.5	150	.8	.3	10	3	.2	10	D184601
D184602	.1L	1	.3	100	.8	.5	5	5	.5	4.8	D184602
D184603	.2	1.5	.7	300	3.0	1.6	7	5	.5	7.4	D184603
D184604	.1L	7	.5	300	8.3	3.0	70	20	2	44	D184604
D184605	.3	5	.6	100	3.0	1.0	50	10	1	15	D184605
D184606	.1L	2	.3	150	1.9	.6	20	10	.7	8.0	D184606
D184607	.2	3	.5	100	1.5	.4	20	5	.3	3.7	D184607
D184608	.2	1.5	.3	100	2.7	1.3	15	3	.3	7.0	D184608
D184609	.1L	7	.9	100	4.6	2.5	70	15	1.5	34	D184609
D184610	.1L	1.5	.2	200	2.7	1.8	50	15	1	18	D184610
D184611	.3	5	.3	300	7.5	2.5	50	10	1	11	D184611
D184612	.4	2	.6	150	2.3	1.2	20	5	.5	11	D184612
D184613	.1L	.5	.1	30	.8	.4	2	1.5	.15	7.5	D184613
D184614	.3	1.5	.2	300	1.3	.7	7	7	.5	4.1	D184614
D184615	.5	N	.4	100	7.1	2.4	100	30	3	49	D184615
D184616	.1L	.3	.1	20	.6	.2L	2	1.5	.1	3.0	D184616
D203122	B	2	B	100	3.0L	.2L	20	3	.3	B	D203122
D203123	B	5	B	200	3.0L	.2L	50	10	1	B	D203123
D203124	B	2	B	150	3.0L	.2L	20	5	.7	B	D203124
D203125	B	7	B	200	3.0L	.2L	50	7	.7	B	D203125
D203126	B	1	B	50	3.0L	.2L	7	2	.2	B	D203126
D213965	.1L	1	.4	70	.6	.2	7	2	.2	3.1	D213965
D213966	.1	1.5	.3	150	1.3	.3	10	2	.2	6.0	D213966
D213967	.2	2	.1L	300	2.1	.7	20	5	.7	7.5	D213967
D213968	.1L	1	.3	200	.8	.3L	7	2	.2	3.5	D213968
D213969	.2	2	.6	150	3.8	1.5	30	5	.5	14	D213969
D213970	.2	2	.1L	700	3.6	1.5	30	7	.7	12	D213970
D213971	.4	7	1.0	200	3.4	4.5	70	10	1.5	14	D213971
D213972	.5	2	.1L	200	14.0	4.0	20	10	1	6.4	D213972
D213973	.2	1.5	.8	500	2.7	4.8	15	5	.5	10	D213973
D213974	.1	1.5	.6	500	1.8	4.6	15	5	.5	8.1	D213974
D213975	.3	2	.1L	100	6.1	4.5	20	5	.5	16	D213975
D213976	.3	3	.1L	200	5.4	4.8	30	5	.7	10	D213976
D213977	.2	3	.7	150	5.5	4.7	30	7	.7	12	D213977
D213978	.2	7	1.2	300	5.0	4.8	70	10	1.5	16	D213978
D213979	.1	2	.3	100	1.5	4.6	20	2	.2	4.0	D213979
D213980	.1	.5	.3	70	.7	6.2	5	.7	.1	3.9	D213980

Table 17.--Major-, minor-, and trace-element composition of 54 coal samples from the Utukok River quadrangle, Alaska--Continued

Sample number	Zr-S (ppm)
D184598	10
D184599	100
D184600	7
D184601	7
D184602	7
D184603	7
D184604	50
D184605	30
D184606	20
D184607	20
D184608	7
D184609	50
D184610	30
D184611	30
D184612	10
D184613	5
D184614	15
D184615	70
D184616	2
D203122	20
D203123	70
D203124	50
D203125	50
D203126	20
D213965	10
D213966	20
D213967	30
D213968	10
D213969	50
D213970	30
D213971	100
D213972	70
D213973	50
D213974	20
D213975	20
D213976	30
D213977	50
D213978	70
D213979	15
D213980	7

Table 17.--Major-, minor-, and trace-element composition of 54 coal samples from the Utukok River quadrangle, Alaska--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
D213981	0.74	0.46	0.28	0.14	0.029	0.053	0.64	0.025	1.8	50	D213981
D213982	.79	.52	.28	.090	.090	.050	.64	.023	2.2	50	D213982
D213944	.99	.84	.70	.26	.050	.022	.30	.023	2.0	30	D213944
D213945	9.9	4.4	.21	.48	.24	1.1	.99	.24	2.1	30	D213945
D213946	.063	.19	.40	.24	.12	.003	.27	.006	.7	70	D213946
D213947	.93	.71	.22	.12	.17	.066	.19	.039	1.5	50	D213947
D213948	1.8	1.0	.52	.28	.071	.11	.27	.079	2.0	30	D213948
D213949	.038	.13	.29	.14	.090	.005	.15	.004	.8	30	D213949
D213950	.73	.78	.30	.16	.27	.028	.16	.008	1.5	100	D213950
D213951	2.1	1.8	.57	.17	.14	.26	.35	.18	2.9	70	D213951
D213952	.61	.74	.64	.19	.13	.087	.28	.023	2.6	70	D213952
D213953	1.2	1.2	.16	.038	.060	.022	.15	.028	2.2	50	D213953
D213954	.35	.62	.16	.044	.030	.028	.38	.021	1.5	30	D213954
D213955	.30	.30	.036	.024	.032	.024	.16	.013	1.4	70	D213955

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
D213981	700	0.15L	0.11	N	3	5	2.9	30	1.5	N	D213981
D213982	700	.3	.05	N	1.5	5	3.0	40	1.5	N	D213982
D213944	700	.2	.08L	N	7	5	3.7	45	3	N	D213944
D213945	700	1L	.37L	N	7	100	32	27	20	N	D213945
D213946	500	.1L	.03L	B	1.5	2	1.4	20L	.5	N	D213946
D213947	700	.15	.06L	30L	5	7	4.6	40	3	N	D213947
D213948	500	.3	.09L	N	10	30	7.5	55	5	N	D213948
D213949	300	N	.02L	B	1	1.5	1.0	20L	.3	N	D213949
D213950	1,000	.3	.06L	30L	1.5	3	2.3	35	.5L	N	D213950
D213951	2,000	5	.13L	100	15	10	13	310	7	N	D213951
D213952	2,000	.2L	.07L	N	5	3	2.5	35	2	N	D213952
D213953	300	.2	.06L	N	10	2	3.2	20	5	N	D213953
D213954	2,000	.7	.04L	N	3	7	3.2	85	3	1.5	D213954
D213955	150	.15	.02	N	3	3	1.9	25	1.5	N	D213955

Table 17.--Major-, minor-, and trace-element composition of 54 coal samples from the Utukok River quadrangle, Alaska--Continued

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
D213981	0.06	N	1.2	58	N	1L	B	15	220	1.3L	D213981
D213982	.07	N	6.2	56	N	1L	B	15	520	1.3L	D213982
D213944	.07	7L	9.8	17	N	1.5L	N	20	440	4.3	D213944
D213945	.06	30L	47	35	N	7L	N	30	80	9.2L	D213945
D213946	.03	N	1.0	8.1	N	N	B	7	43L	.8L	D213946
D213947	.03	10	7.0	6.6	N	1L	N	15	700	1.4	D213947
D213948	.03	10L	14	11	N	2L	N	20	960	5.0	D213948
D213949	.03	N	.5	5.4	N	N	B	5	44L	.5L	D213949
D213950	.03	10	7.9	5.0	.5	1L	10	10	350	2.0	D213950
D213951	.04	70	24	16	1.5	7	100	15	2,400	11	D213951
D213952	.05	7	8.2	13	N	1.5L	N	20	1,600	1.7L	D213952
D213953	.08	N	19	1.8L	.5L	1.5L	B	15	43L	2.3	D213953
D213954	.05	5	7.6	46	N	1L	N	10	1,700	1.7	D213954
D213955	.07	2	11	5.0	.15L	.5L	N	7	130	1.3	D213955

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
D213981	0.1L	0.7	0.5	70	1.0	5.1	7	3	0.3	11	D213981
D213982	.1	.7	.4	150	2.1	6.1	7	3	.3	10	D213982
D213944	.1	5	.7	100	2.3	2.5	5	7	.7	2.7	D213944
D213945	.6	20	.8	50	5.8	1.9	200	20	2	67	D213945
D213946	.1L	.7	.5	50	.5	.8	5	1.5	.15	2.2	D213946
D213947	.1	1.5	.6	300	1.6	.9	15	3	.3	6.1	D213947
D213948	.2	7	.4	100	2.7	1.3	50	10	1	8.9	D213948
D213949	.1L	.3	.8	30	.3	.4	3	.5	.07	2.0	D213949
D213950	.1	1.5	.7	300	.9	1.5	5	5	.5	6.2	D213950
D213951	.5	7	.1L	2,000	15.0	3.1	200	20	1.5	21	D213951
D213952	.1	1.5	.7	700	.1L	.9	7	5	.5	3.1	D213952
D213953	.1	1.5	.4	70	1.8	.6	10	7	.5	3.9	D213953
D213954	.3	2	.5	700	4.2	1.3	20	5	.3	5.4	D213954
D213955	.1	1	.5	70	1.8	.4	7	2	.15	2.7	D213955

Table 17.--Major-, minor-, and trace-element composition of 54 coal samples from the Utukok River quadrangle, Alaska--Continued

Sample number	Zr-S (ppm)
D213981	10
D213982	10
D213944	30
D213945	70
D213946	5
D213947	15
D213948	50
D213949	3
D213950	10
D213951	20
D213952	30
D213953	50
D213954	20
D213955	20

Table 18.--Elements looked for, but not detected in 118 coal samples from the Healy, Kenai, Seldovia, and Utukok River quadrangles, Alaska

[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 in ash (ppm)
Gold	Au	50
Bismuth	Bi	20
Dysprosium	Dy	100
Erbium	Er	100
Europium	Eu	200
Gadolinium	Ge	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 19.--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 Healy quadrangle, Alaska

[For comparison geometric means for 33 samples from the Powder River region are included (Swanson and others, 1976, tables 31b and 32b). All values are in percent except Kcal/kg, Btu/lb, ash-fusion temperatures, and geometric deviations, and are reported on the as-received basis. Leaders (---) indicate no data. Kcal/kg = 0.556 (Btu/lb). °F = (°C x 1.8) + 32]

	Arithmetic mean	Observed range		Geometric mean	Geometric deviation	Powder River region geometric mean
		Minimum	Maximum			
Proximate and ultimate analyses						
Moisture	24.1	14.8	32.7	23.6	1.2	23.1
Volatile matter	35.5	27.3	38.8	35.3	1.1	32
Fixed carbon	30.1	23.4	33.4	29.9	1.1	36
Ash	10.2	5.2	34.5	9.1	1.6	7.5
Hydrogen	6.3	4.6	6.9	6.2	1.1	6.2
Carbon	46.4	35.6	52.2	46.1	1.1	50.3
Nitrogen	.7	.5	.8	.7	1.2	.9
Oxygen	36.0	24.5	44.6	35.7	1.1	32.9
Sulfur	.2	.1	.7	.2	1.6	.8
Heat of combustion						
Kcal/kg	4,465	3,410	5,120	4,430	1.1	4,860
Btu/lb	8,030	6,130	9,210	7,970	1.1	8,740
Forms of sulfur						
Sulfate	0.01	0.01	0.04	0.01	1.7	0.02
Pyritic	.08	.01	.12	.07	1.9	.29
Organic	.16	.07	.51	.14	1.7	.31
Ash-fusion temperatures, °C						
Initial deformation	1,230	1,170	1,270	1,230	1.0	---
Softening temperature	1,280	1,210	1,320	1,280	1.0	---
Fluid temperature	1,340	1,270	1,390	1,340	1.0	---

Table 20.--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 20 coal samples from the Healy quadrangle, Alaska

[For comparison geometric means for 410 samples from the Powder River region are included (Hatch and Swanson, 1977, table 6a). All samples were ashed at 525°C; all analyses except geometric deviation are in percent. L, indicates less than the value shown. Leaders (---) indicate no data]

Oxide	Arithmetic mean	Observed range		Geometric mean	Geometric deviation	Powder River region geometric mean
		Minimum	Maximum			
(Ash)	12.6	6.5	37.5	11.5	1.5	9.0
SiO_2	35	16	51	33	1.4	28
Al_2O_3	17	8	23	16	1.4	14
CaO	20	2	37	16	2.0	15
MgO	3.3	1.6	7.3	3.1	1.5	3.56
Na_2O	.18	.09L	.53	.15	1.9	.93
K_2O	1.1	.29	2.8	.95	1.7	.28
Fe_2O_3	4.6	1.7	9.1	3.9	1.8	5.8
TiO_2	.87	.57	1.1	.86	1.2	.61
SO_3	7.0	1.0	27	5.2	2.2	14
P_2O_5	.26	.11L	1.2	.09	4.5	---

Table 21.--Arithmetic mean, observed range, geometric mean, and geometric deviation of 39 elements in 20 coal samples from the Healy quadrangle, Alaska

[For comparison, geometric means for 410 samples from the Powder River region are included (Hatch and Swanson, 1977, table 6b). All analyses except geometric deviation 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 where 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	Powder River region geometric mean
		Minimum	Maximum			
			Percent			
Si	2.3	0.51	8.9	1.8	2.0	1.2
Al	1.1	.44	4.6	.97	1.8	.66
Ca	1.5	.54	2.7	1.3	1.7	.98
Mg	.22	.11	.43	.21	1.4	.195
Na	.02	.007L	.077	.012	2.3	.063
K	.14	.01	.87	.091	2.5	.022
Fe	.38	.12	.84	.32	1.9	.37
Ti	.067	.022	.23	.059	1.7	.035
P	.010	.004L	.045	.003	5.3	---
			Parts per million			
Ag	.09	.07	.3	.06	2.4	---
As	3	1	10	2.6	1.8	2
B	50	15	100	30	2.1	50
Ba	500	150	1500	500	1.8	300
Be	.5	.2L	3	.2	3.2	.5
Cd	.15	.06L	.56	.07	3.2	---
Co	5	1.5	10	3	1.9	2
Cr	20	7	70	15	1.7	5
Cu	20	8.2	58	17	1.7	9.5
F	95	35	340	82	1.7	40
Ga	3	1.5	10	3	1.7	2
Hg	.07	.02	.30	.06	1.9	.08
La	7	10	20	7	1.5	---
Li	5	1.3	32	3.7	2.2	3.9
Mn	88	6.1	220	46	3.1	34
Mo	1.5	.7	3	1.5	1.5	1.5
Nb	2	1.5L	7	1.5	1.9	1
Ni	10	5	30	10	1.5	3
Pb	5.4	2L	15	4.5	1.8	5.1
Sb	1.9	.3	8.1	1.3	2.3	.4
Sc	3	1.5	10	3	1.6	1.5
Se	1.6	0.3	11	8	3.5	0.7
Sr	150	70	200	100	1.5	150
Th	4.5	.7	18	2.5	3.0	3.3
U	1.3	.4	5.2	1.1	2.0	.6
V	30	15	100	20	1.7	10
Y	7	3	20	7	1.8	3
Yb	.7	.3	3	.7	1.7	.3
Zn	14	2.3	46	8.8	2.6	12.5
Zr	15	7	70	15	1.7	15

Table 22.--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 10 coal samples from the Kenai quadrangle, Alaska

[For comparison, geometric means for 33 samples from the Powder River region are included (Swanson and others, 1976, tables 31b and 32b). All values are in percent except Kcal/kg, Btu/lb, ash-fusion temperatures, and geometric deviations, and are reported on the as-received basis. Leaders (---) indicate no data. Kcal/kg = 0.556 (Btu/lb). °F = (°C x 1.8) + 32]

	Arithmetic mean	Observed range		Geometric mean	Geometric deviation	Powder River region geometric mean
		Minimum	Maximum			
Proximate and ultimate analyses						
Moisture	21.7	18.0	26.5	21.5	1.1	23.1
Volatile matter	36.5	30.0	43.2	36.2	1.1	32
Fixed carbon	27.0	20.5	33.1	26.6	1.2	36
Ash	15.3	4.8	26.9	12.7	1.8	7.5
Hydrogen	6.0	5.3	6.6	6.0	1.1	6.2
Carbon	42.6	35.4	50.3	42.2	1.1	50.3
Nitrogen	.8	.6	1.1	.8	1.2	.9
Oxygen	35.4	30.8	40.2	35.3	1.1	32.9
Sulfur	.4	.2	1.3	.3	1.7	.8
Heat of combustion						
Kcal/kg	4,070	3,430	4,770	4,035	1.1	4,860
Btu/lb	7,320	6,170	8,580	7,260	1.1	8,740
Forms of sulfur						
Sulfate	0.02	0.02	0.03	0.02	1.1	0.02
Pyritic	.06	.01	.12	.04	2.7	.29
Organic	.29	.16	1.29	.24	1.8	.3
Ash-fusion temperatures, °C						
Initial deformation	1,120	1,020	1,240	1,120	1.1	---
Softening temperature	1,180	1,040	1,290	1,180	1.1	---
Fluid temperature	1,240	1,070	1,340	1,230	1.1	---

Table 23.—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 10 coal samples from the Kenai quadrangle, Alaska

[For comparison, geometric means for 410 samples from the Powder River region are included (Hatch and Swanson, 1977, table 6a). All samples were ashed at 525°C; all analyses except geometric deviation are in percent. L, indicates less than the value shown. Leaders (---) indicate no data]

Oxide	Arithmetic mean	Observed range		Geometric mean	Geometric deviation	Powder River region geometric mean
		Minimum	Maximum			
(Ash)	15.2	5.8	25.7	13.0	1.8	9.0
SiO_2	42	16	54	39	1.5	28
Al_2O_3	16	10	21	16	1.2	14
CaO	9.1	4.1	23	7.5	1.9	15
MgO	4.9	3.3	8.1	4.8	1.3	3.56
Na_2O	3.2	.40	6.1	2.2	2.5	.93
K_2O	1.5	.39	4.1	1.3	1.8	.28
Fe_2O_3	5.3	2.2	14	4.5	1.8	5.8
TiO_2	.75	.57	.97	.74	1.2	.61
SO_3	4.5	2.3	6.8	4.1	1.5	14
P_2O_5	.84	1.0L	1.7	.77	1.5	---

Table 24.—Arithmetic mean, observed range, geometric mean, and geometric deviation of 36 elements in 10 coal samples from the Kenai quadrangle, Alaska

[For comparison, geometric means for 410 samples from the Powder River region are included (Hatch and Swanson, 1977, table 6b.). All analyses except geometric deviation 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, indicates less than the value shown. Leaders (---) indicate no data]

Element	Arithmetic mean	Observed range		Geometric mean	Geometric deviation	Powder River region geometric mean
		Minimum	Maximum			
			Percent			
Si	3.5	0.45	6.0	2.4	2.5	1.2
Al	1.4	.35	2.2	1.1	1.9	.66
Ca	.76	.32	1.1	.70	1.5	.98
Mg	.41	.14	.57	.37	1.5	.195
Na	.44	.018	.68	.21	3.5	.063
K	.22	.020	.32	.14	2.6	.022
Fe	.45	.21	.74	.41	1.5	.37
Ti	.07	.02	.12	.06	1.9	.035
P	.04	.040L	.046	.04	1.2	---
			Parts per million			
As	3.5	2	5	3.4	1.3	2
B	30	10	70	20	1.8	50
Ba	500	500	700	500	1.2	300
Be	.7	.2L	1.5	.5	1.9	.5
Co	7	5	10	7	1.2	2
Cr	20	7	50	20	2.0	5
Cu	20	7.4	35	17	1.7	9.5
F	37	20L	75	31	1.8	40
Ga	5	1.5	10	5	2.0	2
Hg	.07	.01	.12	.05	2.0	.08
Li	6.5	1L	13	4	2.8	3.9
Mn	150	50	290	120	1.9	34
Mo	3	1.5	5	3	1.5	1.5
Nb	3	2L	7	3	1.8	1
Ni	15	7	20	10	1.5	3
Pb	---	---	---	---	---	5.1
Sb	0.7	0.2	1.3	0.6	1.8	.4
Sc	5	1	7	3	1.9	1.5
Se	.2	.1L	.3	.1	1.7	.7
Sr	150	50	300	100	1.8	150
Th	---	---	---	---	---	3.3
U	.7	.5L	1.2	.7	1.5	.6
V	70	15	150	50	2.0	10
Y	10	5	20	10	1.6	3
Yb	1.5	.5	2	1	1.7	.3
Zr	20	7	50	20	2.0	15
Zn	9.6	2.6	24	7.1	2.2	12.5

Table 25.--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 6 coal samples from the Seldovia quadrangle, Alaska

[For comparison geometric means for 33 samples from the Powder River region are included (Swanson and others, 1976, tables 31b and 32b). All values are in percent except Kcal/kg, Btu/lb, and geometric deviations, and are reported on the as-received basis. Leaders (---) indicate no data. L, indicates less than value shown. Kcal/kg = 0.556 (Btu/lb)]

	Arithmetic mean	Observed range		Geometric mean	Geometric deviation	Powder River region geometric mean
		Minimum	Maximum			
Proximate and ultimate analyses						
Moisture	16.4	11.0	22.3	15.9	1.3	23.1
Volatile matter	40.1	38.4	41.4	40.1	1.0	32
Fixed carbon	30.2	27.1	33.0	30.1	1.1	36
Ash	13.6	8.3	23.5	12.4	1.5	7.5
Hydrogen	5.8	5.2	6.3	5.8	1.1	6.2
Carbon	47.4	45.4	50.0	47.3	1.0	50.3
Nitrogen	1.0	.9	1.1	1.0	1.1	.9
Oxygen	32.1	24.6	37.9	31.7	1.2	32.9
Sulfur	.4	.3	.4	.3	1.2	.8
Heat of combustion						
Kcal/kg	4,525	4,385	4,790	4,520	1.0	4,860
Btu/lb	8,140	7,890	8,610	8,130	1.0	8,740
Forms of sulfur						
Sulfate	0.01	0.01L	0.01	0.01	1.0	0.02
Pyritic	.02	.01	.04	.02	1.9	.29
Organic	.33	.22	.42	.31	1.3	.31
Ash-fusion temperatures, °C						
Initial deformation	---	---	---	---	---	---
Softening temperature	---	---	---	---	---	---
Fluid temperature	---	---	---	---	---	---

Table 26.--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 34 coal samples from the Seldovia quadrangle, Alaska

[For comparison, geometric means for 410 samples from the Powder River region are included (Hatch and Swanson, 1977, table 6a). All samples were ashed at 525°C; all analyses except geometric deviation are in percent. L, indicates less than the value shown. Leaders (---) indicate no data]

Oxide	Arithmetic mean	Observed range		Geometric mean	Geometric deviation	Powder River region geometric mean
		Minimum	Maximum			
(Ash)	15.0	6.0	49.1	13.1	1.7	9.0
SiO_2	37	14	54	35	1.4	28
Al_2O_3	18	7.9	25	18	1.3	14
CaO	14	2.9	25	12	1.7	15
MgO	1.9	.75	4.0	1.7	1.5	3.56
Na_2O	1.4	.38	6.4	1.0	2.1	.93
K_2O	1.6	.48	3.1	1.4	1.6	.28
Fe_2O_3	6.5	2.6	17	5.9	1.5	5.8
TiO_2	.75	.34	1.1	.72	1.3	.61
SO_3	6.2	2.3	16	5.6	1.6	14
P_2O_5	1.3	.10L	3.1	.46	4.4	---

Table 27.--Arithmetic mean, observed range, geometric mean, and geometric deviation of 37 elements in 34 coal samples from the Seldovia quadrangle, Alaska

[For comparison, geometric means for 410 samples from the Powder River region are included (Hatch and Swanson, 1977, table 6b.). All analyses except geometric deviation 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, indicates less than the value shown. Leaders (---) indicate no data]

Element	Arithmetic mean	Observed range		Geometric mean	Geometric deviation	Powder River region geometric mean
		Minimum	Maximum			
			Percent			
Si	2.9	0.47	11	2.1	2.3	1.2
Al	1.6	.31	6.3	1.2	2.1	.66
Ca	1.2	.99	1.6	1.2	1.1	.98
Mg	.15	.06	.41	.13	1.6	.195
Na	.15	.02	.47	.10	2.4	.063
K	.24	.03	1.3	.16	2.6	.022
Fe	.60	.26	2.4	.54	1.6	.37
Ti	.07	.01	.25	.06	2.1	.035
P	.06	.008L	.13	.03	3.2	---
			Parts per million			
As	8.6	2	25	7.2	1.8	2
B	20	5	70	20	2.0	50
Ba	500	150	1000	500	1.6	300
Be	.5	.2L	1.5	.3	2.2	.5
Co	5	2	15	5	1.5	2
Cr	20	2	70	15	2.2	5
Cu	22	7.1	86	18	1.8	9.5
F	72	20	290	55	2.1	40
Ga	5	1	15	3	2.1	2
Hg	.09	.03	.40	.08	1.8	.08
La	5	5	30	3	2.5	---
Li	5.9	.6	26	3.6	2.7	3.9
Mn	100	40	240	90	1.6	34
Mo	1.5	.5L	15	1.5	2.1	1.5
Nb	1	1.5L	5	.7	3.3	1
Ni	10	5	20	10	1.5	3
Pb	3.1	1.5L	11	2.0	2.6	5.1
Sb	1.2	.2	3.7	1.0	1.8	.4
Sc	5	1	15	3	2.0	1.5
Se	.9	.1	2.1	.4	3.5	.7
Sr	200	100	500	200	1.5	150
Th	2.5	1.9	6.9	2.2	1.6	3.3
U	.7	.3	3.1	.5	2.3	.6
V	50	10	200	50	2.3	10
Y	5	2	20	5	1.7	3
Yb	.7	.2	2	.5	1.7	.3
Zn	10	2.1	110	7	2.4	12.5
Zr	20	7	70	15	2.0	15

Table 28.--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 24 coal samples from the Utukok River Quadrangle, Alaska

[For comparison geometric means for 86 coal samples from the Rocky Mountain province 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. Leaders (---) indicate no data. Kcal/ kg = 0.556 (Btu/lb). °F = (°C x 1.8) + 32]

	Arithmetic mean	Observed range		Geometric mean	Geometric deviation	Rocky Mountain province geometric mean
		Minimum	Maximum			
Proximate and ultimate analyses						
Moisture	10.4	1.8	25.5	8.1	2.0	10.5
Volatile matter	32.2	25	40	31.9	1.1	35.7
Fixed carbon	48.3	32.8	58.6	47.8	1.2	41.5
Ash	9.3	2.3	37.2	6.8	2.2	7.7
Hydrogen	5.3	4	5.8	5.2	1.1	5.6
Carbon	62.8	46.1	72.5	62.2	1.1	58.9
Nitrogen	1.4	1	1.8	1.4	1.2	1.1
Oxygen	22.6	11.3	36.7	21.3	1.4	22.4
Sulfur	.3	.2	.5	.3	1.3	.5
Heat of combustion						
Kcal/kg	5,990	4,505	7,685	5,915	1.2	6,180
Btu/lb	10,770	8,100	13,820	10,640	1.2	11,110
Forms of sulfur						
Sulfate	---	---	---	---	---	0.02
Pyritic	---	---	---	---	---	.11
Organic	---	---	---	---	---	.22
Ash-fusion temperatures, °C						
Initial deformation	1,240	1,140	1,600	1,240	1.1	---
Softening temperature	1,270	1,170	1,600	1,260	1.1	---
Fluid temperature	1,300	1,190	1,600	1,300	1.1	---

Table 29.--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 54 coal samples from the Utukok River quadrangle, Alaska

[For comparison, geometric means for 295 coal samples from the Rocky Mountain province are included (Hatch and Swanson, 1977, table 3a). All samples were ashed at 525°C; all analyses except geometric deviation are in percent. L, indicates 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)	9.3	2	38.9	7.3	2.0	10.9
SiO_2	34	3.8	61	29	1.8	44
Al_2O_3	22	8.4	36	21	1.4	19
CaO	11	.80	38	8	2.1	6.2
MgO	3.8	1.0	12	3.5	1.7	1.4
Na_2O	2.2	.45	7.1	1.6	2.2	.68
K_2O	1.5	.12	4.2	1.2	2.0	.45
Fe_2O_3	8.1	1.8	33	6.8	1.8	4.5
TiO_2	1.5	.25	5.6	1.2	2.0	.81
SO_3	7.8	.34	17	4.9	2.7	5.1
P_2O_5	4.5	.05	8.9	.67	7.4	---

Table 30.--Arithmetic mean, observed range, geometric mean, and geometric deviation of 36 elements in 54 coal samples from the Utukok River quadrangle, Alaska

[For comparison, geometric means for 295 coal samples from the Rocky Mountain province 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, 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, indicates 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	1.8	0.063	11	0.93	3.1	2.3
Al	1.1	.13	4.5	.76	2.2	1.1
Ca	.50	.036	2.2	.40	1.9	.48
Mg	.17	.024	.48	.14	1.9	.089
Na	.11	.018	.27	.087	2.0	.055
K	.14	.003	1.4	.07	3.3	.041
Fe	.36	.15	1.3	.32	1.6	.34
Ti	.09	.004	.52	.05	2.8	.047
P	.07	.004	.24	.03	3.7	---
			Parts per million			
As	2.3	.7	8.1	2	1.6	2
B	50	20	100	50	1.6	70
Ba	700	100	2,000	700	1.8	150
Be	.7	.1	5	.3	3.6	.5
Co	5	1	70	3	2.3	1.5
Cr	10	1	100	7	2.9	5
Cu	6.5	1.0	32	4.8	2.2	8.4
F	68	20	310	48	2.3	69
Ga	5	.3	20	3	2.5	3
Hg	.06	.02	.40	.04	1.8	.05
Li	15	.5	84	9.5	2.7	8
Mn	24	1.8L	170	16	2.4	20
Mo	.2	.2	1.5	.07	5.4	1.5
Nb	2	.7	10	.5	6.1	.5
Ni	15	3	30	10	1.9	2
Pb	3.3	1.0	21	1.7	3.1	4.7
Sb	.2	.05	.64	.1	3.0	.3
Sc	3	.3	20	2	2.5	1.5
Se	.5	.1	1.2	.3	2.3	1.2
Sr	200	30	2,000	150	2.4	100
Th	3.2	.3	15	1.6	3.3	2.9
U	2.2	.2	6.2	1.0	3.5	1.1
V	30	2	200	15	3.3	100
Y	7	.5	30	5	2.3	5
Yb	.7	1	3	.5	2.3	.5
Zn	11	2	67	7.7	2.3	6.8
Zr	30	2	100	20	2.5	20