UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Reconnaissance Survey For Coal near Farewell, Alaska

By

E. G. Sloan, G. B. Shearer, J. E. Eason,
and C. L. Almquist

Open-File Report 79-410

1979

CONTENTS

TABLES

ILLUSTRATIONS

RECONNAISSANCE SURVEY FOR COAL NEAR FAREWELL, ALASKA

By E. G. Sloan, G. B. Shearer, J. E. Eason, and C. L. Almquist

INTRODUCTION

A reconnaissance survey for coal was conducted in August 1977 by the U.S. Geological Survey in the Minchumina basin around Farewell, Alaska. The survey area is along the northern front of the Alaska Range from Big River to the western boundary of Mt. McKinley National Park (pl. 1). Survey work was hampered by dense smoke from a large forest-tundra fire in the area.

Most of the area studied is covered with coarse granular Quaternary sediments that unconformably overlie Tertiary sedimentary rocks. Outcrops of bedrock are sparse and occur only in river bluffs, a few residual hills in the Deepbank Creek area, and small stream valleys where the surficial deposits have been sufficiently eroded to expose the underlying bedrock.

Outcrops of subbituminous coal were found along the Little Tonzona River and along the unnamed tributaries of Deepbank Creek. An outcrop of bony coal was found along the Windy Fork of the Kuskokwim River.

ERA Helicopters, Inc., of Anchorage, Alaska, supplied contract helicopter support. Field operations were based at Farewell Lake Lodge. Sample analyses were performed by the Department of Energy (formerly the Bureau of Mines), Coal Laboratory in Pittsburgh, Pennsylvania.

PREVIOUS INVESTIGATIONS

Coal-bearing rocks were found in the Farewell area by Brooks (1911) in 1902 when he traversed the northern foothills of the Alaska Range from South Fork of the Kuskokwim River to Mt. McKinley. Brooks mapped small enfolded exposures of Tertiary rocks in the valleys of the Little Tonzona River and Pingston Creek and also reported coal outcrops immediately southwest of the junction of the two forks of the Kuskokwim River. Priestly reported considerable quantities of lignitic coal exposed in the Big River valley (Brooks 1910, 1911, and 1925).

Fernald (1960) briefly described the surficial geology of the Farewell area and located the Farewell fault but did not identify any Tertiary rocks or coal. Sainsbury and MacKevett (1965) reported thick, nonmarine sedimentary rocks near the White Mountain mercury mines. W. H. Condon reported coal-bearing rocks exposed for several kilometers along the Cheeneetnuk River, including a 2-meter-wide exposure of bright, brittle coal of probable bituminous rank (Barnes, 1967).

Gary Player (written communication, 1970) conducted a reconnaissance survey of the Farewell area in 1970 and reported exposures of Tertiary coal-bearing rocks from the Big River to the Little Tonzona River. A 59-meter sequence of coal-bearing rocks was reported along the Little Tonzona River. Thirty meters of this sequence was described as clean, subbituminous coal. Player reported a second exposure of coal-bearing rocks along the banks of an unnamed tributary of Deepbank Creek. Float and outcrops suggest at least one bed of coal, 6 meters or more thick, there.

GEOLOGIC SETTING

The area described is on the southeastern edge of a gently sloping piedmont surface north of the Alaska Range. The piedmont merges into the lowlands of the upper Kuskokwim River valley. The piedmont and the lowlands form the Minchumina basin, which is part of an area of low relief stretching from the upper Tanana basin in the north to the Holitna lowlands in the southwest. Most of the piedmont and lowlands is covered with coarse granular sediments deposited in glacial moraines, outwash slopes, flood plains, and alluvial fans (Fernald, 1960). Outcrops of bedrock are limited to residual hills, river bluffs, and stream valleys where erosion of surficial gravels has exposed the bedrock.

The Farewell fault separates the Minchumina basin from the Alaska Range. This right-lateral strike-slip fault is part of the Denali fault system. The Farewell fault is the major structural feature in the area and is thought to be responsible for the tilting and folding of the Tertiary coal-bearing sequences that lie north of the fault.

South of the fault, Paleozoic siltstones, argillites, and limestones, intruded locally by porphyritic granitic stocks and dikes, form the Alaska

Range. North of the fault, Devonian limestones and shales are exposed near White Mountain and the Farewell airstrip, and Tertiary nonmarine coal-bearing sequences of conglomerate, sandstone, siltstone, volcanic rock, and coal crop out in scattered places from the Big River to Kantishna.

Rocks immediately south of the Farewell fault are severely deformed, as expressed in the chevron and overturned folds found in the area. Rocks north of the fault appear to be less deformed and are generally tilted and contain minor bedding plane faults as in the Little Tonzona outcrop, or are folded into gentle synclines as in the Windy Fork outcrop.

COAL OCCURRENCE

Outcrops are sparse throughout the region. Few continuously exposed stratigraphic sequences extend more than a few hundred meters. Outcrops of coal were found in streambank cuts along the Little Tonzona River and along the drainages of the unnamed tributary creeks of Deepbank Creek (pl. 1). An outcrop of bony coal (ash content, 30-62 percent) was found along the Windy Fork of the Kuskokwim River.

All samples were collected from hand-dug trenches that extended 15 to 60 centimeters into the outcrop. Bed moisture was preserved by sealing samples in polyethylene-lined canvas bags.

Little Tonzona River Area

An isolated exposure of Tertiary nonmarine sedimentary rocks crops out along the southwest bank of the Little Tonzona River in sec. 27, T. 31 N., R. 20 W., Seward Meridian. The Tertiary strata strike N. 73° E., and dip 47°-63° NW. Three minor bedding plane faults with associated drag folds occur in the section (pl. 2).

Seven seams of coal each at least one meter thick are exposed in this outcrop. Areas of disturbed bedding are not included in the calculations, although they probably represent additional coal beds. Coal samples were taken from shallow trenches and analyzed by the Department of Energy, Coal Laboratory in Pittsburgh, Pennsylvania (table 1). Heating values for the coal ranged from 8,466 to 9,517 Btu per pound on a moist-ash free basis and from 7,848 to 8,295 Btu per pound on an as-received basis. Sulfur content

varied considerably from bed to bed, ranging from 0.7 percent to 1.7 percent (as-received). The outcrop is described in detail below.

Outcrop Description in the Little Tonzona River Area
(from youngest to oldest)

Lithology	Description	Measured Thickness (meters)
Coal	Dull, grayish brown; amber inclusions 1-2 mm in diameter; very woody with whole log casts visible; sample #TS-A-77-22; top of bed not exposed.	1.0
Clay	Dark gray; silty; highly plastic.	1.1
Coal	Dull, grayish brown to black; numerous amber inclusions 1-2 mm in diameter; very woody, especially in the upper portion of the bed with log casts visible; 0.3-meter bony coal parting occurs 3.7 meters above base of unit; sample #TS-A-77-20 was taken above the parting and sample #TS-A-77-18 was taken below the parting; overall equivalent thickness of coal for classification standards is 8.2 meters.	8.8
Clay	Light gray to brown, highly plastic, little or no silt content. Bottom of clay not exposed.	0.2
Covered	Coal float in moderate quantity.	4.3
Fault zone	Mostly composed of folded and/or pulverized coal with some clay partings; amount and direction of displacement unknown. (See pl. 2A.)	3.9
Covered	Gravel cover.	0.6

Lithology	Description	Measured Thickness (meters)
Coal	Reddish brown; moderately woody with some areas of vitrain present; coal is uniform throughout bed with no partings present; sample #TS-A-77-16; top and bottom of bed not exposed.	7.9
Covered	Gravel cover.	1.2
Fault zone	Folded and faulted clay and coal; coal is pulverized; no indication of large-scale offset.	2.54
Clay	Dark gray to black; silty; plastic.	0.9
Coal	Dark gray to brown; moderately woody, especially in the upper part of the unit; bands of vitrain present, especially in lower part of unit; 10-centimeter, light gray, highly plastic clay parting occurs 3.4 meters from bottom of the unit; sample #TS-A-77-15 was taken above the parting and sample #TS-A-77-13 was taken below the parting. Strike is N. 73° E., dip 67° NW. Overall equivalent thickness of coal for *classification standards is 5.3 meters.	5.9
Fault zone	Highly contorted coal and clay; coal is pulverized and folded; thin layer of gravel, similar to overlying gravels, underlies distorted beds; no evidence of repeated section. Overlying coal seems to be a continuation of the same bed as the coal involved in the folding (see pl. 2B).	0.9

Lithology	Description	Measured Thickness (meters)
Clay	Light gray; highly plastic; little or no silt content.	0.08
Coal	Dull brown, with bright bands of vitrain; two dark gray, highly plastic clay partings, one 2.4 cm thick, 4.3 m above the base, and the other 1.2 cm thick, 3.9 m from the base of the unit; ironstone concretions less than 5% by volume; sample #TS-A-77-8; bottom of bed not exposed; overall equivalent thickness of coal for classification standards is 6.7 meters.	6.8
Covered	Gravel cover; 20% of float is coal.	13
Coal	Dull-dark-brown, with numerous bands of vitrain. Two dark gray, highly plastic, silty clay partings: one is 0.15 meters thick and occurs 1.3 meters stratigraphically above the base of the bed; the other is 0.2 meters thick and occurs 2.7 meters above the base of the bed. Sample #TS-A-77-7 was taken in the upper 1.3 meters of coal. Sample #TS-A-77-6 was taken in the lower 2.7 meters of coal. Overall equivalent thickness of coal for classification standards is 3.5 meters.	4.2
Clay	Light gray; highly plastic, little or no silt; bottom of clay bed not exposed.	0.3
Covered	Gravel cover; 40% of float is coal.	19
Coal	Dull-gray-black; very woody; bedding somewhat distorted, with minor undulations	1.8

Lithology	Description	Measured Thickness (meters)
Coal (cont.)	present; strike is N. 38° E., dip 35° NW.; sample #TS-A-77-1; top and bottom of bed not fully exposed.	

Summary and Comparison of Little Tonzona Coals.--Seven coal beds, each at least 1.0 meter thick, were measured in the Little Tonzona outcrop. Calculated on the basis of U.S. Geological Survey Circular 633 (Bass, Smith, and Horn, 1970), these coals yield an aggregate thickness of 34.5 meters, or approximately 41 percent of the measured interval. Of the remaining 49.5 meters of interval, 38.1 meters were covered and the underlying bedrock could not be determined, and 7.3 meters were in faulted areas.

Analyses (table 1) indicate that, except for the sulfur content, the coal is similar in rank and quality to Tertiary Alaskan coals in the Nenana field; the Little Tonzona coal contains about three times the percentage of sulfur in coal from the Nenana field.

Upper Tributaries of Deepbank Creek Area

Outcrops are sparse through sec. 13, T. 30 N., R. 20 W., Seward Meridian. Coal beds are the dominant outcrop-forming rock, usually occurring in 1 to 1.5-meter outcrops of highly weathered coal. Complete thickness was almost impossible to ascertain, owing to heavy vegetative cover. Samples were taken on a 1.4-meter bed and a 6.3-meter bed. The two measured outcrops are described below.

First outcrop in the Deepbank Creek Area

Lithology	Description	Measured Thickness (meters)
Coal	Highly weathered; reddish brown; vitreous; weathers into large flat plates; strike	1.4

Lithology	Description	Measured Thickness (meters)
Coal (cont.)	N. 35° E., dip 38° NW.; sample #TS-A-77-24; top and bottom of bed not exposed.	

The second outcrop sampled is along the east bank of another tributary of Deepbank Creek, sec. 13, T. 30 N., R. 20 W., Seward Meridian, where a 7.9 meter-section is exposed around a small knoll and in a stream channel (pl. 3).

Second outcrop in Deepbank Creek Area
(from youngest to oldest)

Lithology	Description	Measured Thickness (meters)
Coal	Dark-gray-black; vitreous, lower part of coal increasingly woody, coal surfaces are slickensided; strike N. 60° E., dip 48°-55° NW.; sample #TS-A-77-27; top of bed not exposed.	6.3
Shale	Very dark gray; carbonaceous; bottom of bed not exposed.	1.6

Summary and Comparison of Deepbank Creek Coals.--Weathered samples (table 1) taken from outcrops along the upper tributaries of Deepbank Creek are comparable in rank and quality to Tertiary Alaskan coals of the Nenana field. The sulfur content is lower than for the coals from Little Tonzona and is roughly the same or slightly higher than for the Nenana coal. The dip of bedding is steep (48°-55°); however, owing to the proximity of the outcrop areas to the Farewell fault, the steep dips recorded may not be representative of regional structural attitudes. Additional information

from drilling would be necessary to determine both the structural configuration and thickness variation of the coal as it extends into the Minchumina Basin.

Windy Fork Area

Description.--Thick beds of bony slickensided coal crop out along the west bank of the Windy Fork of the Kuskokwim River.

A stratigraphic section was measured in the west limb of a north-trending syncline. Conglomerate, sandstone, siltstone, and bony coal are the dominant components of the 267.5 meters of section measured. The section is described below, and illustrated on Plate 4. The sample analyses are in Table 1.

Measured Stratigraphic Section
in the Windy Fork Area
(from youngest to oldest)

Lithology	Description	Measured Thickness (meters)
Bony coal	Dull black with bands of vitreous material; slickensided; interval of high vitrinous material in the center 0.6 meters of bed; strike is N. 30° W., dip is 39° NE.; sample #TS-A-77-50; top and bottom of bed not exposed.	2.2
Covered	Gravel and vegetation cover.	4.7
Conglomerate	Light brown to tan; contains sandstone stringers; sandstone stringers become part of a fining upward sequence from pebble conglomerate to fine-grained sandstone in upper third of the bed; contains wood fragments and fragments of coal as lag deposits; channel deposits identifiable; upper and lower contacts not exposed.	31.5

Lithology	Description	Measured Thickness (meters)
Covered	Gravel and vegetation cover.	14.5
Conglomerate, sandstone	Cobble to pebble conglomerate, grading grading upward into a medium- to fine-grained sandstone. Gradational sequence repeated several times. Conglomerate is light brown to tan, subangular to subrounded; sandstone is light brown to tan, top of bed not exposed.	5.6
Coal, shale	Interbedded, individual beds 2 to 4 centimeters thick; coal frequently has bright bands of vitrain; shale is dull-gray-black carbonaceous; coal comprises 85% of upper half of unit and 40% of lower half; strike N. 30° W.; dip 41° NE.; top of interval not exposed.	23.6
Sandstone, siltstone	Gray weathering to brown; sandstone is fine-siltstone to medium-grained and grades upward into siltstone.	2.1
Shale, coal	Interbedded, beds 2-4 cm thick; coal frequently has bright bands of vitrain; shale is dull-gray-black, carbonaceous; 40-50% coal; bottom of bed not exposed.	7.1
Covered	Heavy vegetation cover.	3.8
Coal, shale	Interbedded, beds 3-5 cm thick; coal has numerous bright bands of vitrain; shale is dull-gray-black, carbonaceous; coal comprises 85% of upper half and 40% of lower half; strike N. 30° W., dip 41° NE.; top of interval not exposed.	16.6

Lithology	Description	Measured Thickness (meters)
Sandstone, siltstone	Sandstone is light gray to tan, very fine-grained, grades upward into a light gray siltstone.	0.9
Bony coal	Contains fine-grained sandstone lenses; slickensided; bony coal intervals from 5-35 cm thick.	1.3
Sandstone	Light gray to tan; plant fossils; sandstone is coarse-grained in lower portion and becomes finer upward, gradational contact with bony coal.	2.4
Shale, coal	Interbedded; individual beds 2-60 cm thick; coal is dull-gray-black with some bands of vitrain, comprises 30% of the interval.	23.2
Siltstone, sandstone	Siltstone is gray, weathering to brown; sandstone is medium-grained; contains plant fossils and thin coal stringers.	1.8
Shale, coal	Interbedded shale and coal; 30-40% coal.	2.0
Siltstone, sandstone	Interbedded; siltstone is gray, weathering to brown; sandstone is gray, weathering to brown, medium-grained, contains plant fossils and thin coal stringers.	2.0
Siltstone, sandstone, coal	Interbedded; coal 10% in lower part and up to 60% in upper; sequence grades upward into overlying sandstone.	10.2
Siltstone	Dark gray, weathering to brown; contains sandstone stringers and plant fossils.	0.9

Lithology	Description	Measured Thickness (meters)
Coal, shale	Interbedded; individual beds 2-10 cm thick; coal is dull brown, with some bands of vitrain; shale is dark gray. Coal comprises approximately 75% of the total bed.	2.9
Siltstone, sandstone, coal	Interbedded; individual beds less than 10 cm thick; vitreous coal makes up 50% of the interval; gray fossiliferous brown-weathering siltstone makes up 20% of the lower half of the unit, increasing to 40% in the upper half of the unit; fine-grained, gray sandstone is 30% of the lower half of the unit, decreasing to 10% in the upper half of the unit.	9.2
Coal	Vitreous; highly fractured; slickensided; a 0.1-m fossiliferous siltstone parting 0.8 m above base is gray weathering to brown. Sample #TS-A-77-45; overall thickness of coal for classification standards is 5.1 m.	5.3
Siltstone	Gray, weathering to brown; fossiliferous.	0.8
Bone	Carbonaceous shale with coal; coal fragments vitreous, slickensided; carbonaceous shale dull black, slickensided; sample #TS-A-77-43.	3.9
Siltstone	Dark gray; carbonaceous; contains wood and plant fragments.	0.6
Bony coal	Dull-gray-black with bright bands of vitrain; fragmented, slickensided;	10.5

Lithology	Description	Measured Thickness (meters)
Bony coal (cont.)	contains 10% sandstone lenses and partings; sample #TS-A-77-41.	
Bony shale	Dark gray, with bands of vitrain; 60% shale, 40% coal.	5.3
Sandstone	Dark gray, weathering to light gray; fine-grained.	3.6
Bony coal	Dull-gray-black with numerous bands of vitrain; slickensided; contains 10% partings of sandstone and shale, with sandstone partings more numerous near top; sample #TS-A-77-39.	4.6
Sandstone	Dark gray, weathering to buff gray; fine- to medium-grained.	1.6
Covered	Coal float present.	13.4
Bone	Dull gray with bands of vitrain; slickensided; sample #TS-A-77-37; top and bottom of bed not exposed.	6.3
Covered	Coal float present.	3.9
Sandstone	Gray brown, weathering dark brown to tan; medium-grained; contains plant fossils.	2.0
Coal, sandstone	Dull gray with vitrain bands; contains thin stringers of sandstone; thickness of individual coals range from 2-10 cm thick; sample #TS-A-77-35.	2.9
Coal, sandstone	Interbedded; coal is highly fractured, slickensided, vitreous; sandstone is grayish brown, fine-grained.	4.8

Lithology	Description	Measured Thickness (meters)
Bony coal	Dull-gray-brown; woody; contains concretions of ironstone up to 30 centimeters in diameter.	1.5
Sandstone	Grayish brown, weathering to light brown, fine-grained.	9.9
Bone	Dull-gray-black with bands of vitrain; numerous clay partings; sample #TS-A-77-32.	2.7
Siltstone	Dark gray, weathering to light gray; contains wood fragments; coarsens downward into very fine-grained sandstone.	0.5
Sandstone	Dark gray, weathering to light gray or tan; very fine grained; strike N. 20° E., dip 37° SE.	14.4
Bony coal	Numerous clay partings (10%); sample #TS-A-77-39.	0.5
Claystone	Light gray; contains wood fragments; bottom of bed not exposed.	0.2

SUMMARY AND CONCLUSIONS

The data indicate the presence of a large resource of subbituminous coal in the Farewell area. Neither the areal extent of the coal-bearing rocks nor the maximum depth of their burial is known. If the steep dips recorded at the outcrop are regionally representative, most of the resource would lie far below the surface, and mining by conventional methods would probably not be economic; however, the observed attitudes may simply reflect localized tilting and faulting adjacent to the Farewell fault.

The presence of bituminous coal on Windy Fork, as well as reports of bituminous coal farther southwest along the Cheeneetnuk River, suggests that the coal tends to increase in rank southwestward from the Little Tonzona River outcrop.

The extent, depth of burial, and actual (unweathered) quality of the coals in the area cannot be determined without drilling.

TABLE 1

COAL ANALYSES

(All samples weathered)

A.--Little Tonzona Outcrop — T. 31 N., R. 20 W., Section 27, Seward Meridian

Sample #	Thickness (meters)	Dip	USDOE #	FSI**	Sample Conditions*	BTU/lb	Proximate Analysis: Moisture (Mod)	Proximate Analysis: Volatile Matter	Proximate Analysis: Fixed Carbon	Proximate Analysis: Ash	Ultimate Analysis: Hydrogen	Ultimate Analysis: Carbon	Ultimate Analysis: Nitrogen	Ultimate Analysis: Oxygen (Ind)	Ultimate Analysis: Sulfur	Ultimate Analysis: Ash
TS-A-77-1	1.8	35°	K80540	0.5	A	7,848	25.3	35.6	32.3	6.8	6.0	46.9	0.5	38.8	1.0	6.8
					B	10,505	--	47.7	43.1	9.2	4.3	62.8	0.7	21.8	1.3	9.2
					C	11,564	--	52.5	47.5	--	4.7	69.1	0.8	24.0	1.5	--
					D	8,466										
TS-A-77-6	2.7	47°	K80541	0.5	A	8,137	19.1	40.1	30.9	9.9	5.7	48.1	0.7	33.8	1.7	9.9
					B	10,058	--	49.6	38.1	12.3	4.5	59.4	0.9	20.8	2.1	12.3
					C	11,466	--	56.6	43.4	--	5.1	67.7	1.0	23.7	2.4	--
					D	9,111										
TS-A-77-7	1.3	47°	K80542	0.5	A	7,947	22.5	37.9	30.7	8.9	6.1	46.7	0.7	36.5	1.1	8.9
					B	10,259	--	49.0	39.6	11.4	4.6	60.3	0.9	21.3	1.4	11.4
					C	11,586	--	55.3	44.7	--	5.2	68.1	1.0	24.0	1.6	--
					D	8,790										
TS-A-77-8	6.8	47°	K80543	0.5	A	8,295	21.5	41.0	29.8	7.7	6.1	48.4	0.7	35.9	1.2	7.7
					B	10,564	--	52.2	38.0	9.8	4.7	61.6	0.9	21.4	1.6	9.8
					C	11,707	--	57.9	42.1	--	5.2	68.3	1.0	23.7	1.8	--
					D	9,047										
TS-A-77-13	3.1	67°	K80544	0.5	A	8,018	21.5	40.3	30.1	8.1	5.9	47.5	0.6	36.5	1.4	8.1
					B	10,217	--	51.4	38.3	10.3	4.5	60.5	0.8	22.1	1.8	10.3
					C	11,392	--	57.3	42.7	--	5.0	67.5	0.8	24.7	2.0	--
					D	8,784										
TS-A-77-15	2.3	67°	K80545	0.5	A	8,164	16.0	40.7	31.6	11.7	5.4	48.8	0.7	32.1	1.2	11.7
					B	9,724	--	48.5	37.6	13.9	4.3	58.2	0.9	21.3	1.4	13.9
					C	11,295	--	56.3	43.7	--	5.0	67.5	1.0	24.7	1.7	--
					D	9,347										
TS-A-77-16	7.9	67°	K80546	0.5	A	8,022	19.6	40.7	31.8	7.9	5.7	47.9	0.7	36.7	1.1	7.9
					B	9,974	--	50.6	39.5	9.9	4.4	59.5	0.9	24.0	1.4	9.9
					C	11,067	--	56.2	43.8	--	4.9	66.0	1.0	26.6	1.5	--
					D	8,768										
TS-A-77-18	3.7	67°	K80547	0.5	A	8,210	14.5	41.8	32.1	11.6	5.3	48.3	0.5	33.1	1.1	11.6
					B	9,598	--	48.8	37.6	13.6	4.3	56.5	0.6	23.7	1.3	13.6
					C	11,108	--	56.5	43.5	--	5.0	65.4	0.7	27.4	1.5	--
					D	9,388										
TS-A-77-20	4.8	67°	K80548	0.5	A	8,237	15.3	43.6	30.2	10.9	5.4	47.9	0.6	34.4	0.7	10.9
					B	9,728	--	51.5	35.6	12.9	4.4	56.5	0.7	24.5	0.8	12.9
					C	11,169	--	59.1	40.9	--	5.0	64.9	0.9	28.2	1.0	--
					D	9,337										
TS-A-77-22	1.0	67°	K80549	0.5	A	8,075	20.0	42.5	31.1	6.4	5.7	47.8	0.6	38.8	0.7	6.4
					B	10,095	--	53.1	38.9	8.0	4.4	59.8	0.8	26.3	0.9	8.0
					C	10,972	--	57.7	42.3	--	4.7	65.0	0.8	28.6	1.0	--
					D	8,673										

B.--Outcrops in the Deepbank Creek Area - T. 30 N., R. 20 W., Section 13, Seward Meridian

TS-A-77-24	1.4+	38°	K80550	0.5	A	8,186	21.5	36.0	35.9	6.6	5.7	49.1	0.7	37.2	0.7	6.6
					B	10,429	--	45.9	45.7	8.4	4.2	62.5	0.8	23.0	0.9	8.4
					C	11,386	--	50.1	49.9	--	4.6	68.2	0.9	25.1	1.0	--
					D	8,813										
TS-A-77-27	6.3	55°	K80551	0.5	A	8,828	14.7	42.9	35.7	6.7	5.5	52.6	1.0	34.0	0.2	6.7
					B	10,354	--	50.3	41.8	7.9	4.6	61.7	1.2	24.5	0.3	7.9
					C	11,240	--	54.6	45.4	--	5.0	66.9	1.3	26.6	0.3	--
					D	9,517										

C.--Windy Fork Outcrop - Samples are Bony Coal - T. 27 N., R. 26 W., Section 19, Seward Meridian

TS-A-77-29	.5	37°	K80552	0.5	A	6,627	3.3	25.5	28.8	42.4	3.5	38.4	1.2	14.3	0.2	42.4
					B	6,856	--	26.4	29.7	43.9	3.2	39.7	1.3	11.7	0.2	43.9
					C	12,212	--	47.1	52.9	--	5.7	70.8	2.2	20.9	0.3	--
					D	12,232										
TS-A-77-32	2.7	40°	K80553	0.5	A	4,123	3.4	29.6	8.9	58.1	2.5	26.2	0.6	12.5	0.1	58.1
					B	4,270	--	30.6	9.2	60.2	2.2	27.1	0.6	9.8	0.1	60.2
					C	10,724	--	76.9	23.1	--	5.6	68.1	1.5	24.6	0.3	--
					D	11,071										
TS-A-77-35	2.9	40°	K80554	0.5	A	6,357	3.7	24.5	28.4	43.4	3.4	38.4	0.9	13.8	0.2	43.4
					B	6,602	--	25.4	29.6	45.0	3.1	39.9	0.9	10.9	0.2	45.0
					C	12,013	--	46.3	53.7	--	5.6	72.5	1.7	19.8	0.3	--
					D	11,971										
TS-A-77-37	6.3	40°	K80555	0.5	A	5,551	2.5	23.8	22.8	50.9	3.2	32.9	0.9	12.0	0.2	50.9
					B	5,694	--	24.4	23.4	52.2	2.9	33.7	0.9	10.0	0.2	52.2
					C	11,910	--	51.0	49.0	--	6.2	70.5	1.9	21.0	0.5	--
					D	12,336										
TS-A-77-39	4.6	40°	K80556	0.5	A	7,228	3.5	26.8	30.2	39.5	3.7	41.4	1.0	14.1	0.3	39.5
					B	7,487	--	27.7	31.4	40.9	3.4	42.9	1.1	11.4	0.3	40.9
					C	12,671	--	46.9	53.1	--	5.8	72.5	1.8	19.3	0.6	--
					D	12,616										
TS-A-77-41	10.5	40°	K80557	0.5	A	5,981	2.8	23.4	26.5	47.3	3.3	35.8	0.9	12.4	0.2	47.3
					B	6,153	--	24.0	27.3	48.7	3.1	36.8	0.9	10.2	0.2	48.7
					C	11,994	--	46.9	53.1	--	6.0	71.8	1.8	19.9	0.4	--
					D	12,234										
TS-A-77-43	3.9	40°	K80558	0.5	A	3,968	1.9	18.7	16.6	62.8	2.5	23.9	0.7	10.1	0.1	62.8
					B	4,043	--	19.1	16.9	64.0	2.3	24.3	0.7	8.6	0.1	64.0
					C	11,224	--	53.0	47.0	--	6.4	67.6	2.0	23.9	0.2	--
					D	12,338										
TS-A-77-45	5.2	40°	K80559	0.5	A	8,438	3.7	31.2	35.2	29.9	4.2	48.7	1.2	15.6	0.4	29.9
					B	8,766	--	32.5	36.5	31.0	3.9	50.6	1.2	12.8	0.4	31.0
					C	12,711	--	47.1	52.9	--	5.7	73.4	1.8	18.5	0.6	--
					D	12,473										
TS-A-77-50	2.2	39°	K80560	0.5	A	5,504	4.0	24.8	23.5	47.7	3.3	33.6	1.3	13.7	0.4	47.7
					B	5,735	--	25.8	24.5	49.7	2.9	35.0	1.4	10.5	0.4	49.7
					C	11,409	--	51.3	48.7	--	5.9	69.6	2.8	21.0	0.8	--
					D	11,363										

* Sample Conditions: A - As received
B - Moisture Free
C - Moisture-Ash Free
D - Moist-Ash Free, calculated using Moist, Mm-free Btu = (Btu - 50S)/[100 - (1.08A + 0.55S)] x 100
using values from the as received analysis

**Free Swelling Index (FSI)

REFERENCES

Barnes, F. F., 1967, Coal resources of Alaska: U.S. Geol. Survey Bull. 1242-B, 36 p.

Bass, N. W., Smith, H. L., and Horn, G. H., 1970, Standards for the classification of public coal lands: U.S. Geol. Survey Circular 633, 10 p.

Beikman, H. M., 1974, Preliminary geologic map of the southwest quadrant of Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-611.

Brooks, A. H., 1910, Alaska coal and its utilization: U.S. Geol. Survey Bull. 442-A, p. 47-100.

_____1911, The Mount McKinley region, Alaska: U.S. Geol. Survey Professional Paper 70, 234 p.

_____1925, Alaska's mineral resources and production 1923: U.S. Geol. Survey Bull. 773-A, p. 3-52.

Capps, S. R., 1919, The Kantishna region, Alaska: U.S. Geol. Survey Bull. 687, 116 p.

Fernald, A. T., 1960, Geomorphology of the upper Kuskokwim region, Alaska: U.S. Geol. Survey Bull. 1071-G, p. 191-279.

Herreid, Gordon, 1968, Geology and geochemical investigations southwest of Farewell, Alaska: Alaska Div. of Mines and Minerals Geological Report 26.

Sainsbury, C. L., 1965, Previously undescribed Middle(?) Ordovician, Devonian(?), and Cretaceous(?) rocks, White Mountain area, near McGrath, Alaska, in Geological Survey Research 1965: U.S. Geol. Survey Professional Paper 525-C, p. 91-95.

Sainsbury, C. L., and MacKevett, E. M., Jr., 1965, Quicksilver deposits of southwestern Alaska: U.S. Geol. Survey Bull. 1187, 89 p.

Wahrhaftig, Clyde, Wolfe, J. A., Leopold, E. B., and Lanphere, M. A., 1969, The coal-bearing group in the Nenana coal field, Alaska: U.S. Geol. Survey Bull. 1274-D, p. 1-30.