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SOUTHERN KENAI PENINSULA

(HOMER DISTRICT)

COAL-RESOURCE ASSESSMENT AND

MAPPING PROJECT

FINAL REPORT

Cooperative Geologic Mapping Project (COGEOMAP) No. 14-08-0001-A0377

of

Alaska Division of Geological and Geophysical Surveys (DGGS)
794 University Avenue, Suite 200, Fairbanks, Alaska 99709

and

United States Geological Survey (USGS) Branch of Coal Resources
Federal Center, Denver, Colorado 80225

DGGS Public-data File 87-15

by

R.D. Merritt[1], L.L. Lueck[1], S.E. Rawlinson[1], M.A. Belowich[1,2], K.M. Goff[1], J.G. Clough[1], and Linda Reinink-Smith[2]

THIS REPORT HAS NOT BEEN REVIEWED FOR TECHNICAL CONTENT (EXCEPT AS NOTED IN TEXT) OR FOR CONFORMITY TO THE EDITORIAL STANDARDS OF DGGS

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August, 1987

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CONVERSION FACTORS

To convert from	Multiply by
Inches to centimeters	2.54
Centimeters to inches	0.394
Feet to meters	0.305
Meters to feet	3.281
Miles to kilometers	1.609
Kilometers to miles	0.621
Acres to hectares	0.405
Hectares to acres	2.471
Square miles to acres	640
Pounds to kilograms	0.454
Kilograms to pounds	2.2
Short ton to metric ton	0.907
Metric ton to short ton	1.016
Degrees Fahrenheit (°F) to degrees Celsius (°C)	(1)
Degrees Celsius (°C) to degrees Fahrenheit (°F)	(2)
Btu to calories	252
Btu to kilocalories	0.252
Btu/lb to kJ/kg	2.326

(1) Temperature in °C = 5/9 (°F -32)
(2) Temperature in °F = 9/5 °C +32

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ABSTRACT

This report represents the first major study of the coal resources of the Kenai Peninsula in nearly 30 yr. It focuses on the Homer district, an 1,100 mi^2 area of the southern Kenai coal field. Coal deposits of the region are contained in the Beluga Formation (late Miocene) and Sterling Formation (late Miocene to Pliocene) of the Kenai Group.

Continuous, overlapping, low-angle 35-mm photographs were made of the coal-bearing rocks exposed in seacliffs along Cook Inlet and Kachemak Bay. The photographs were used effectively for planning field work, as a base for locating and plotting sample locations in the field, for studying bedding and structural features, and for resolving correlation problems. New coal maps of the region were compiled at scales of 1:63,360 and 1:125,000. Over 140 channel samples of coal beds were collected and analyzed for petrology, quality, and geochemistry. Plant-fossil, palynology, sandstone, overburden, and volcanic-ash samples were also taken at selected sites. Volcanic-ash partings, gross lithologic characteristics, and coal petrology serve as aids to coal-seam correlation. High inertinite bands present in Sterling Formation coals on Cook Inlet and Kachemak Bay sides of the peninsula indicate that they may be age-correlative.

Coals of the region have been divided into three units for simplification and display of analytical data---(1) Cook Inlet (west side) Sterling Formation coals; (2) Kachemak Bay (south side) Beluga Formation coals; and (3) Kachemak Bay (east side) Sterling Formation coals. Petrologic studies of coals include maceral, microlithotype, and vitrinite reflectance analyses. The older, higher-rank coals of the Beluga Formation show higher vitrinite reflectance values (average reflectance of 0.37 percent), lower moisture and volatile matter contents, and higher fixed carbon contents and heating values than Sterling Formation coals. All coals exhibit low trace-element contents and very low sulfur contents.

Areas with coal-development potential on the southern Kenai Peninsula have been divided into 11 resource blocks (arranged in order of highest to lowest estimated amounts of resources)---Homer, Canyons, Kachemak Bay, Lower Deep Creek, Ninilchik, Plateau, Happy Creek, Anchor Point, Clam Gulch, Upper Deep Creek, and Cape Starichkof. The Homer district of the Kenai coal field contains calculated measured, identified, and hypothetical coal resources of 57.6, 347.2, and 41,550 million short tons, respectively.

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ACKNOWLEDGMENTS

The authors would like to thank those colleagues and friends who contributed to the completion of this final project report. G.R. Eakins coordinated early efforts in defining the project, writing the project proposal, and directing field-planning efforts. The project was greatly assisted by Dr. P.D. Rao and J.E. Smith of the University of Alaska Mineral Industry Research Laboratory (MIRL), Fairbanks. Dr. Rao granted use of MIRL's coal analytical facilities. The authors would also like to thank the U.S. Geological Survey, particularly G.D. Stricker and R.H. Affolter of the Branch of Coal Resources, Denver for cooperation and assistance in carrying out this study.

INTRODUCTION TO PROJECT AREA

Location and Extent

The southern Kenai Peninsula (south of Tustumena Lake and the Kasilof River), southern Kenai lowland, and Homer district of the Kenai coal field all describe the project study area as defined in this report, and hence will be used synonymously throughout the text. The Kenai coal field is essentially correlative in area with the Kenai lowland, a region occupying about 3,600 mi^2 (fig. 1). The Kenai lowland is part of the Cook Inlet Tertiary basin, a trough over 300 km long and 100 km wide and up to 8,000 m deep. The northern part of the Kenai lowland and Kenai coal field, which is referred to as the Kenai district (Barnes and Cobb, 1959), will not be discussed in this report. The southern part of the Kenai lowland and Kenai coal field (fig. 2), which is referred to as the Homer district (Barnes and Cobb, 1959), includes an 1,100 mi^2 area on the southwest side of the Kenai Peninsula between the Kenai Mountains and Cook Inlet. The Homer district is about 100 mi southwest of Anchorage.

Access and Settlements

Principal towns on the southern Kenai Peninsula include Clam Gulch, Ninilchik, Anchor Point, and the regional center, Homer (fig. 2). Transportation depends largely on the two-lane Sterling Highway connecting with the Alaska highway system and extending along the west coast of the peninsula from Soldotna to Homer, landing strips at several towns, an airport at Homer, and shipping in and out of the port on Homer Spit. Homer is located near the base of the 5-mi-long Homer Spit, which extends nearly halfway across the mouth of Kachemak Bay (Barnes, 1951). Smaller residential and other roads provide access to some of the interior region of the lowland, mostly around Homer.

Physiography

Elevations are around 2,700 ft in the Caribou Hills and up to about 2,000 ft on the ridge at the north shore of Kachemak Bay and elsewhere in the interior, 1000 ft at Bluff Point, but much of the southern Kenai lowland is 500 ft or less above sea level, with local relief up to 250 ft (Martin, 1915a; Barnes and Cobb, 1959). The southeastern half of the Homer district southwest of Tustumena Lake is a broad rolling upland with summits to 1,300 ft that

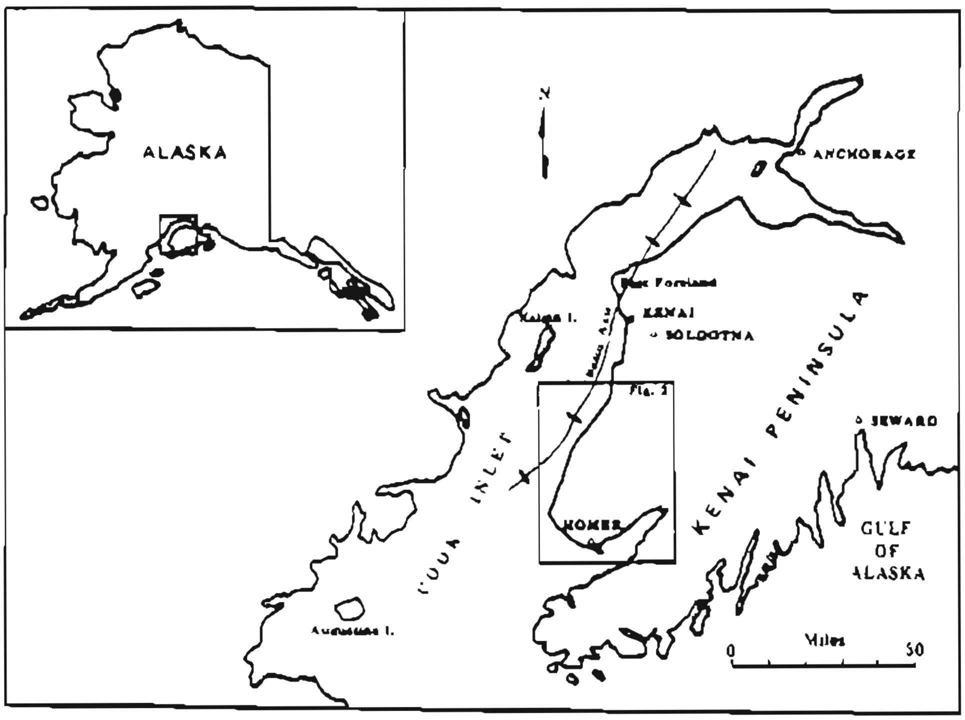

Figure 1. General location of study area---the Homer district of the Kenai coal field, southern Kenai lowland, Kenai Peninsula.

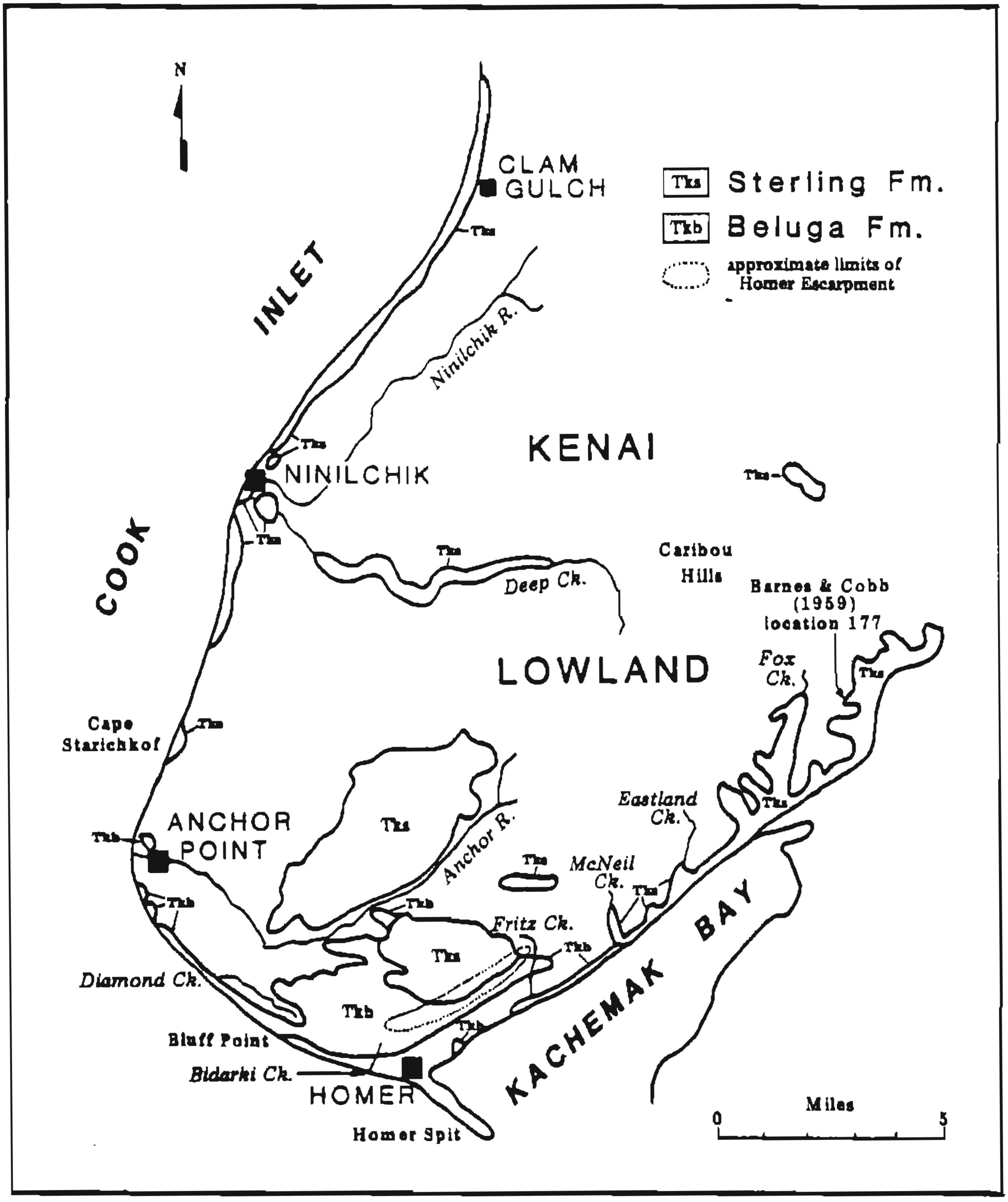

Figure 2. Generalized geologic map of the Homer district, Kenai coal field showing approximate outcrop extent of the Beluga and Sterling Formations. Modified from Sisson, 1985.

generally decreases in elevation southwestward. The western half of the Homer district is relatively flat and poorly drained (Barnes and Cobb, 1959). The Kasilof River, the second largest in volume on the Kenai Peninsula, flows 15 mi to Cook Inlet from its source in Tustumena Lake (Martin, 1915a). Surface drainage is not well integrated over most of the lowland, reflecting a history of late Pleistocene glaciation (Reger, 1985). The lowland contains a variety of glacial and fluvioglacial forms including moraines, outwash plains, kames and eskers (Karlstrom, 1955). Most of the coast of Cook Inlet and Kachemak Bay is bounded by steep wavecut cliffs form tens to hundreds of feet high broken intermittently by streams and gullies. Topography is locally modified by surface creep or slumping of soft sediments on steep slopes and by landslides (Barnes, 1951).

Important physiographic features (fig. 2) include the bluff north of Homer that Barnes and Cobb (1959) called the Homer Escarpment and the short, rugged canyons that erode it; tall seacliffs carved in light colored sandstones and shales just west of Homer at Bluff Point; deeply incised stream valleys and canyons near the head of Kachemak Bay; and several other large stream valleys, such as those of the Ninilchik River and Deep Creek along Cook Inlet, Diamond Creek and Bidarki Creek west of Homer, and Fritz Creek and McNeil Creek along Kachemak Bay. Because most of the southern Kenai lowland is covered by Quaternary till and other surficial deposits, the stream canyon and seacliff exposures are the only places where coal beds can be studied and sampled.

Previous Investigations

Barnes and Cobb (1959) recounted details of early investigations on the Kenai Peninsula. The first geologic investigations were made by Dall in 1880. Dall and Harris (1892) began sampling and measuring coal-bearing sections on the Kenai Peninsula; they described beds along the northwest shore of Kachemak Bay and as far north as Cape Ninilchik. In 1895, Dall reexamined and sampled several prospects and developments on Kachemak Bay (Dall, 1896). Another detailed study of the coal deposits of the Homer district was made by Kirsopp around 1900 (Kirsopp, 1903). G.C. Martin headed a geologic field expedition which studied the coal-bearing rocks at Kachemak Bay in 1904 (Stone, 1906). Atwood studied the rocks in the same area in 1906 (Atwood, 1909). Martin returned to the Homer district in 1911 and later prepared a report summarizing all previous investigations (Martin, 1915b).

Barnes and Cobb (1959) is the most recent detailed study on the Tertiary coal-bearing rocks of the southern Kenai lowland. This excellent basic study summarizes the results of their field investigations in the Homer district. The report includes detailed descriptions of the Cook Inlet outcrops and many of the thicker coal beds; partial stratigraphic columns of continuous bedrock exposures; and proximate analyses, rank and heating values of 18 coal samples. Barnes and Cobb (1959) did their work before current stratigraphic units had been defined for the area, and thus their maps show only undifferentiated Tertiary Kenai Group ('Kenai Formation') coal-bearing strata. They omitted detailed stratigraphy between their coal beds, which resultantly makes some of their locations suspect. In addition, their stratigraphic columns are sometimes uncorrelated or correlated with queries.

Calderwood and Fackler (1972) divided the Kenai Group into five formal formations, whose names have been widely accepted. The oldest of these units, the West Foreland Formation, was later removed from the group because it is not coal-bearing (Fisher and Magoon, 1978). The upper two formations---the Beluga and Sterling Formations---crop out in the southern Kenai lowland.

Adkison and others (1975) measured an incomplete section of the Beluga Formation over 3,000 ft thick where well exposed near Homer. Rawlinson (1984) did a detailed study of the Beluga and Sterling Formations on the Kachemak Bay side of the Kenai lowland. Sisson (1985) summarized many aspects of the geology in the study area; a portion of plate I from his guidebook has been modified as figure 2 and used as a generalized geology map in the present report.

History of Coal Development

Archeological evidence indicates that the earliest Eskimo cultures of the Kachemak Bay region used coal for fuel (Barry, 1973). Captain Nathaniel Portlock, an English trader, sailed to the Cook Inlet and Kenai Peninsula in 1786 from the Hawaiian Islands and discovered coal deposits at Coal Cove on the north side of Port Graham below Dangerous Cape. Early Russian settlers extracted minor quantities of coal for use in their shipyards and steamers. Some coal was reportedly used by Aleksandr Baranov of the Shelikhov-Golikov Company in 1798 to smelt iron at Kodiak, but because the coal burned too hot, the resulting iron was impure (Barry, 1973).

In 1849-1850 the Russian explorer and mining engineer Peter Doroshin came to the southern Kenai Peninsula area and explored the coal beds at Coal Cove and surrounding regions for the Russian Trading Company. In 1855 the Russian-American Company was formed and opened the first coal mine in Alaska at Coal Cove, Port Graham (Martin, 1915b); this mine was probably also the oldest on the Pacific Coast of North America. Rapid development in California after the gold rush created a demand for coal, and a 500-ton shipment was sent to San Francisco in 1856 but sold for less than the cost of mining. Although the Port Graham mine was a financial failure, it continued to produce coal until 1867 when the United States assumed possession of Alaska.

Coal has been mined in the Homer district of the Kenai coal field since 1888 when the Alaska Coal Company began operations on the north side of Kachemak Bay and drove a tunnel into the Bradley Seam at Fritz Creek about 1 mi south of Millers Landing. In 1891 Lt. R.P. Schwerin of the U.S. Navy mined 200 tons of coal in McNeil Canyon west of Coal Point (Homer Spit) for testing in San Francisco. In 1894 the North Pacific Mining and Transportation Company began exploration in Eastland and McNeil Canyons, 14 mi northeast of Homer. Between 1894 and 1897, the company continued prospecting and made extensive preparations for coal development, but ultimately produced 650 tons. Extensive prospecting and tunneling occurred in the Curtis Seam around the turn-of-the-century (fig. 3). In 1899 the Cook Inlet Coal Fields Company took over controlling interest in the north Kachemak Bay coal field on Bidarki Creek west of Homer (fig. 4). In 1901-1902, the company produced a few hundred tons of coal for the mail steamer <u>Discovery</u> and other vessels. In 1902 a railroad was built to the end of Homer Spit.

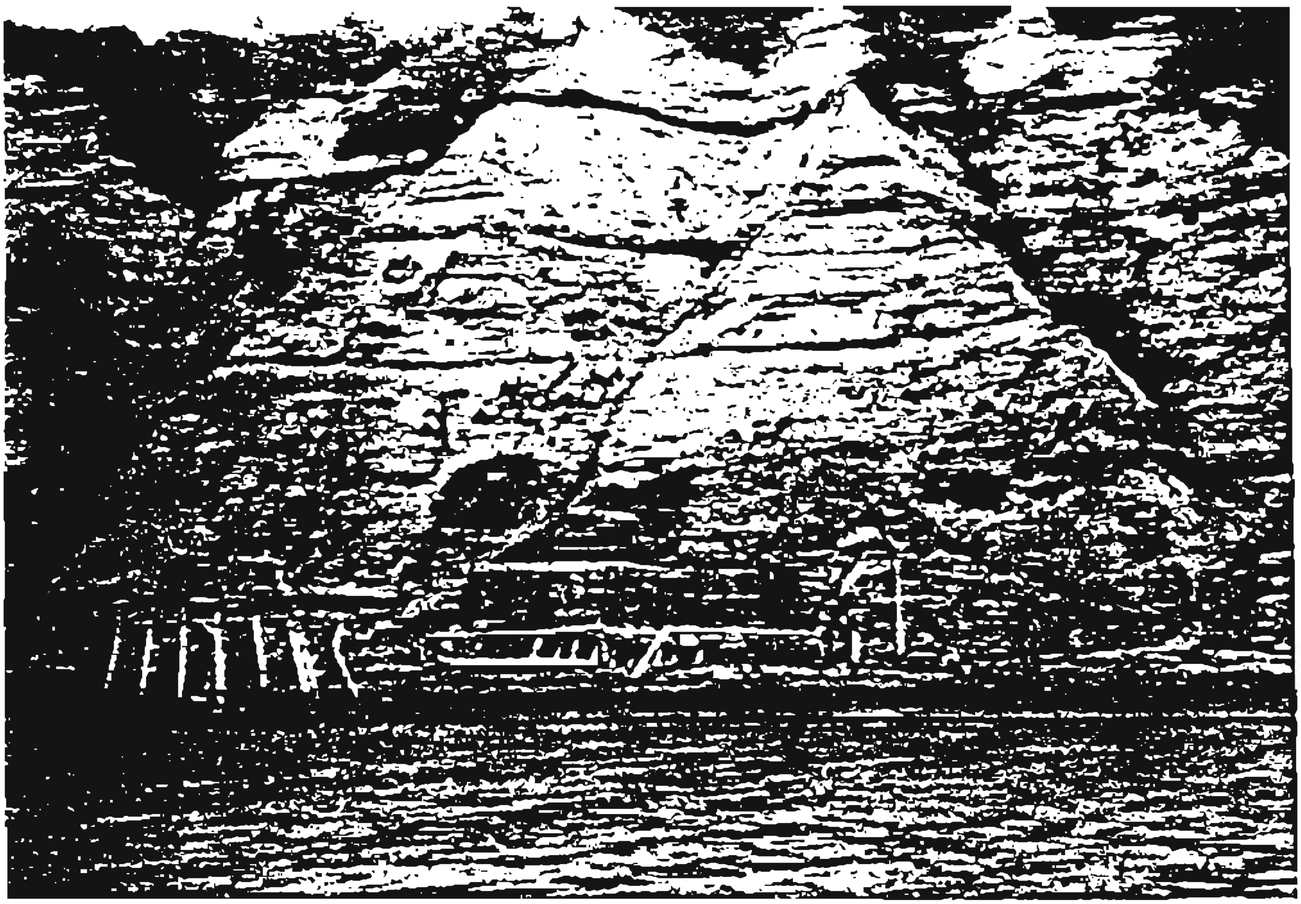

Figure 3. Outcrop of the Curtis seam west of Homer, southern Kenai Peninsula, with the ruins of the wharf and bunker. Reproduced from Stone, 1906.

Figure 4. Beluga Formation deposits at Bidarki Creek. Second coal bed from the bottom is the 1.8-m thick Cooper Bed (Barnes and Cobb, 1959), which was readied for production near here from 1899 to 1902; little coal was produced. Photograph by S.E. Rawlinson, June 1986.

Between 1902 and 1915 the coal fields near Homer were dormant. About 100 tons of coal per day (seasonal) were produced in 1915 on a 65-acre lease tract at Bluff Point (Wharf Mine), 2.4 km west of Homer for use by the fish canneries of Cook Inlet. The mine produced between 20,000-25,000 tons of coal before closing in 1924 (Barnes, 1951). In 1946 the Homer Coal Corporation developed a mine in the Cooper Bed (frontispiece) near the site of the old Bluff Point mine; development, testing, and small-scale mining continued at the site until 1951. In 1959, two strip mines operated intermittently at Homer. Since then, no further activity has taken place in the Homer area (Barry, 1973), although local residents have continued to pick up coal from the beach and elsewhere for home use. Historic coal mining in the Homer district was always modest (Barnes and Cobb, 1959).

GENERAL GEOLOGY OF PROJECT AREA

Distribution of Coal-bearing Rocks

Kenai Group coal-bearing rocks are believed to underlie the entire Kenai lowland. They were originally inferred to underlie this region because similar rocks were exposed to the north and west across Cook Inlet. This was later confirmed when several thousand feet of coal-bearing rocks were penetrated in oil wells of the Swanson River field (Barnes, 1967). They comprise the only pre-Quaternary bedrocks exposed in this broad region. Barnes and Cobb (1959) measured and correlated detailed stratigraphic sections of the beach bluffs along the shores of Cook Inlet and Kachemak Bay.

Coal-bearing rocks are exposed at many points in the Homer district, an 1100 mi^2 area, but are largely limited to coastal bluffs and the banks of larger streams (Barnes, 1967). The exposures are not continuous but include at least 50 mi of beachcrop. Typical beach outcrops are 100 to 300 ft high and steep-sided. Since coal beds of the region are most resistant to erosion, they form cappings on sediments, and result in waterfalls in stream bottoms and canyons (Toenges and Jolley, 1949).

The best-known of the outcrop areas on the south shore of Kachemak Bay is the one on the eastern shore of Port Graham (Martin, 1915b), which contains the coal beds discovered by Portlock in 1786. Coal-bearing outcrops are almost continuous along the northwest shore of Kachemak Bay (fig. 5). They extend for several miles northeast of the head of Kachemak Bay in the cliffs on the western wall of the valley of Fox River. Coal exposures are found extensively on steep bluffs along the east shore of Cook Inlet and are found intermittently along the coast between Kasilof and Homer, including deposits in the vicinity of Ninilchik, Happy Valley and the Homer Escarpment.

Most of the Homer district is covered by a relatively thin mantle (to several tens of feet, locally to several hundred feet) of unconsolidated glacial and alluvial deposits of Quaternary age (Barnes and Cobb, 1959). Krinsley (1953) reported deposits of loess, or wind-blown silt, to 2-ft thick in the Homer-Anchor Point area. Barnes and Cobb (1959) noted the landslide debris locally at the foot of beach bluffs, especially southeast of Bluff Point. Reger (1979) described in detail the Bluff Point landslide.

Figure 5. Coal-bearing Sterling Formation deposits northwest of McNeil Creek on Kachemak Bay. Fault displaces section upward on the right side of the right gully. Major coal beds on the left side of the fault include from bottom to top, the E, F, G, H, and I beds of Barnes and Cobb (1959); the bottom coal bed on the right side of the fault is bed D. Photograph by S.E. Rawlinson, July 1977.

In the Kenai district to the north, not included in this study, bedrock is completely concealed by glacial and alluvial deposits. Barnes (1967) states that these deposits were at least several hundred feet thick throughout the Kenai district precluding the economic recoverability of the coal deposits under present conditions.

Structural Geology

The Shelikof trough, of which the southern Kenai lowland forms a part, developed as a forearc basin of the Alaska - Aleutian Range (Kelley, 1985). Exposures of Kenai Group coal-bearing strata along the shores of Cook Inlet and Kachemak Bay outline a broad structural basin. The simple Bouguer gravity map of figure 6 shows that the Tertiary sedimentary rocks of the Kenai lowland correlate with gravity lows to 150 milligals. Basinal rocks have been modified by gentle folds and high-angle faults with displacements ranging from inches to 80 ft (Barnes, 1967). Deposits at Port Graham on the south side of Kachemak Bay are limited by the Border Ranges fault to areas within a narrow strip along the coast (Magoon and others, 1976).

Structure of Kenai Group coal-bearing rocks of the Homer district, southern Kenai lowland is relatively simple with local minor warping. Dips are generally less 5°, but range up to 12° (Barnes, 1951). Fold axes trend northeast, dips have a north component, and at most locations are to the northwest. Small, near-vertical faults (figs. 7 and 8) also generally strike northwest (Barnes and Cobb, 1959). Horizontal beds are found in many exposures.

Lithostratigraphy and Correlation

Dall and Harris (1892) classed Tertiary coal-bearing strata on Kenai Peninsula and elsewhere as 'Kenai Formation.' Calderwood and Fackler (1972) assigned group status to the 'Kenai Formation' and established the stratigraphic nomenclature for individual formations. One of the formations, the West Foreland Formation, was later excluded from the group (Fisher and Magoon, 1978).

The Kenai Group (Oligocene-Pliocene) consists of four formations (oldest to youngest): the Hemlock Conglomerate and the Tyonek, Beluga, and Sterling Formations. The Kenai Group consists of over 26,000 ft of clastic sediments---sandstone, siltstone, conglomerate---and coal (Hite, 1976; Fisher and Magoon, 1978). The total thickness of the Kenai Group was determined in oil wells and from seismic work. Sediments in the Cook Inlet basin are thickest near Nikishka, East Foreland, which is a few tens of miles north of our project area, the Homer district. They gradually thin northeastward and southwestward along the basin axis, eastward where they lap onto rocks of the ancestral Kenai and Chugach Mountain Ranges, and westward toward the Alaska Range (Calderwood and Fackler, 1972).

Kenai Group coal-bearing rocks represent the only exposed bedrock on the Kenai lowland, with only the Beluga and Sterling Formations exposed in the Homer district, southern Kenai Peninsula. Exposures of coal in beachcrops occur along the north shore of Kachemak Bay and adjoining eastern shore of

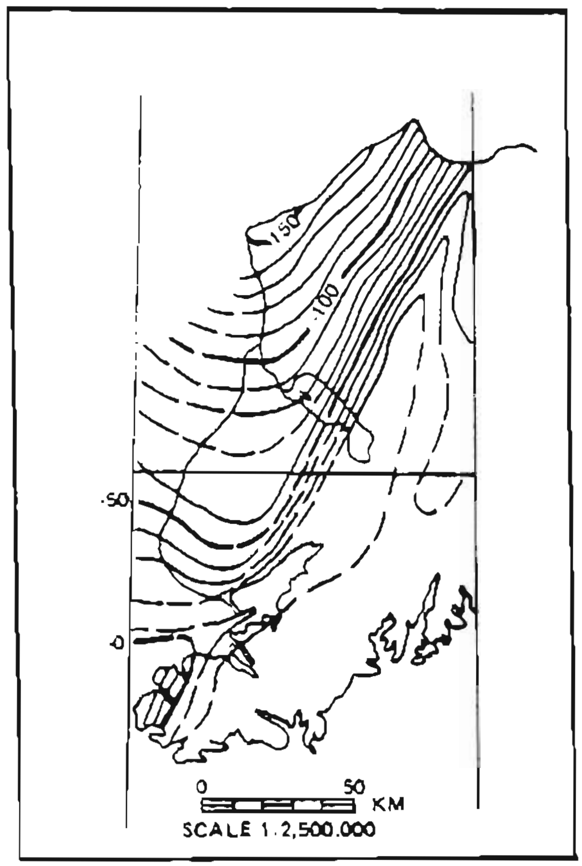

Figure 6. Generalized Bouguer gravity map of Kenai Peninsula. From Barnes, 1977. Gravity contours indicate simple Bouguer anomalies in milligals. Contour interval 10 milligals.

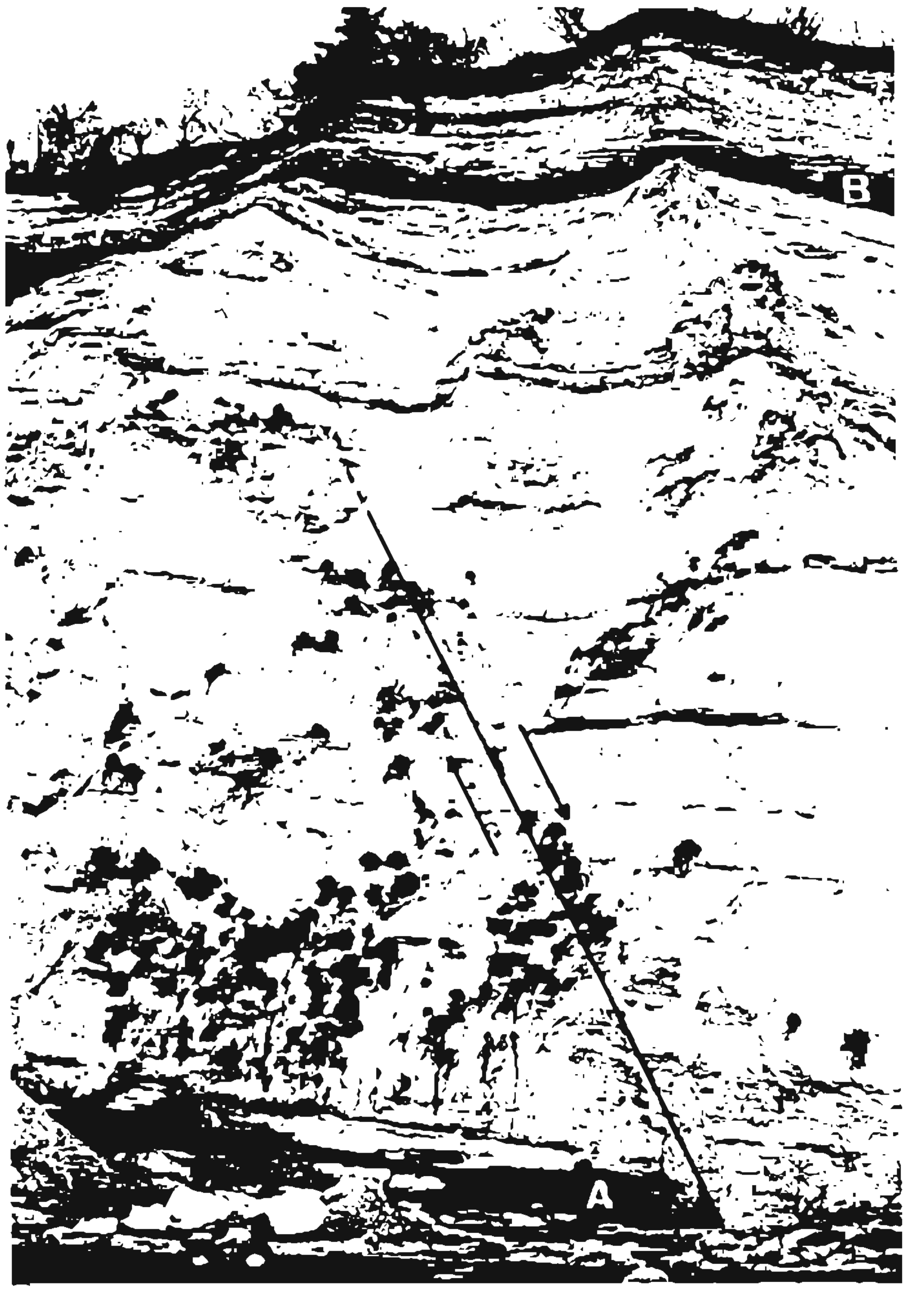

Figure 7. Normal fault in Beluga Formation along Kachemak Bay that truncates coal bed A of Barnes and Cobb (1959). Coal bed is about 1.3 m thick; note all-terrain vehicle for scale. Photograph by S.E. Rawlinson, June 1986.

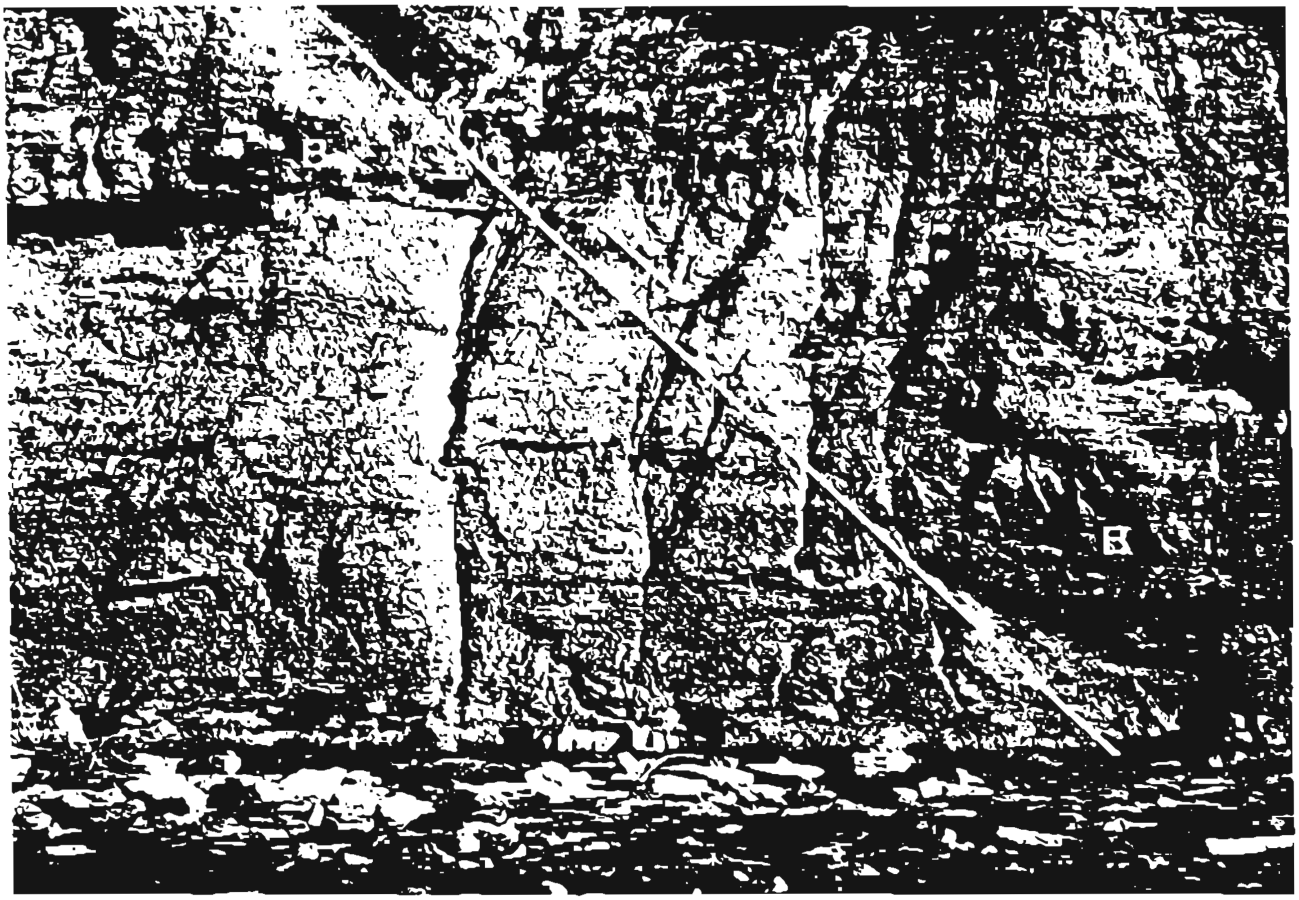

Figure 8. Normal fault with apparent vertical offset of about 8 m; note person for scale. Fault displaces coal bed B in Beluga Formation southwest of McNeil Creek on Kachemak Bay. The coal bed burned after displacement. Photograph by S.E. Rawlinson, July 1977.

Cook Inlet. The upper few hundred meters of the Beluga Formation are exposed in seacliffs in upper Kachemak Bay and west of Homer (Hayes and others, 1976). Northward from Cape Starichkof toward Ninilchik along Cook Inlet, progressively younger Sterling Formation beds are exposed in seacliffs (Barnes and Cobb, 1959).

Type sections of the Beluga and Sterling Formations are defined only in the subsurface based on various oil well logs (for example, resistivity, radioactivity, and sound-wave velocity). The Beluga Formation was named and its type section designated from the discovery well of the Sterling gas field which was drilled by Union Oil Company in 1961.

The Kenai Group unconformably overlies the Eocene West Foreland Formation. The Beluga Formation disconformably overlies the Tyonek Formation, and the Sterling Formation disconformably overlies the Beluga Formation (Calderwood and Fackler, 1972). The Beluga Formation is over 5,000 ft thick (fig. 9) and the Sterling Formation is over 7,000 ft thick (fig. 10).

The stratigraphically lowest beds in the project area are assigned to the Beluga Formation and occur in the coastal bluffs southeast of Anchor Point. The stratigraphically highest coal-bearing beds are assigned to the Sterling Formation and occur at the heads of Fox and Swift Creeks and north of Clam Gulch (Barnes and Cobb, 1959). Except for a few local reversals due to minor folding, progressively younger beds are exposed northward along the coast from Cape Starichkof.

The upper Beluga Formation is composed of alternating thin conglomerate, gray to dark gray, conglomeratic to fine-grained sandstone, gray siltstone and mudstone, and coal (Calderwood and Fackler, 1972). Although characterized by a lower proportion of sandstone than the Sterling Formation, some of the sandstone beds near the top are fairly thick, and these are composed mainly of metasedimentary rock fragments (Hayes and others, 1976).

The Sterling Formation is composed primarily of thick-bedded (30- to 90-ft), coarse- to medium-grained sandstones (fig. 11) separated by thinner beds of siltstone, claystone, and coal; it displays well-defined upward-fining sequences. Clastics are made up of quartz, plagioclase, and volcanic rock fragments (Hayes and others, 1976).

Approximately 5 percent of the Tertiary Kenai Group strata is composed of subbituminous and lignitic coal beds. These coal beds exhibit marked lenticularity (Barnes, 1967). Coal beds of the Beluga Formation are thicker than those in the Sterling Formation. The coal beds decrease both in number and thickness northward. This change was noted by Barnes and Cobb (1959) north of Clam Gulch and at their locality 177 northeast of Fox Creek Canyon.

The Beluga and Sterling Formations differ in ways that can be identified without borehole logs. Figure 12 summarizes differences in degree of induration, provenance, clay mineralogy, heavy-mineral suites, thickness and number of coal beds, and age between the two formations. In addition, each formation exhibits distinct lithologic successions, sedimentary structures, and bedding characteristics. Lithologic sequence and sedimentary structures are poorly

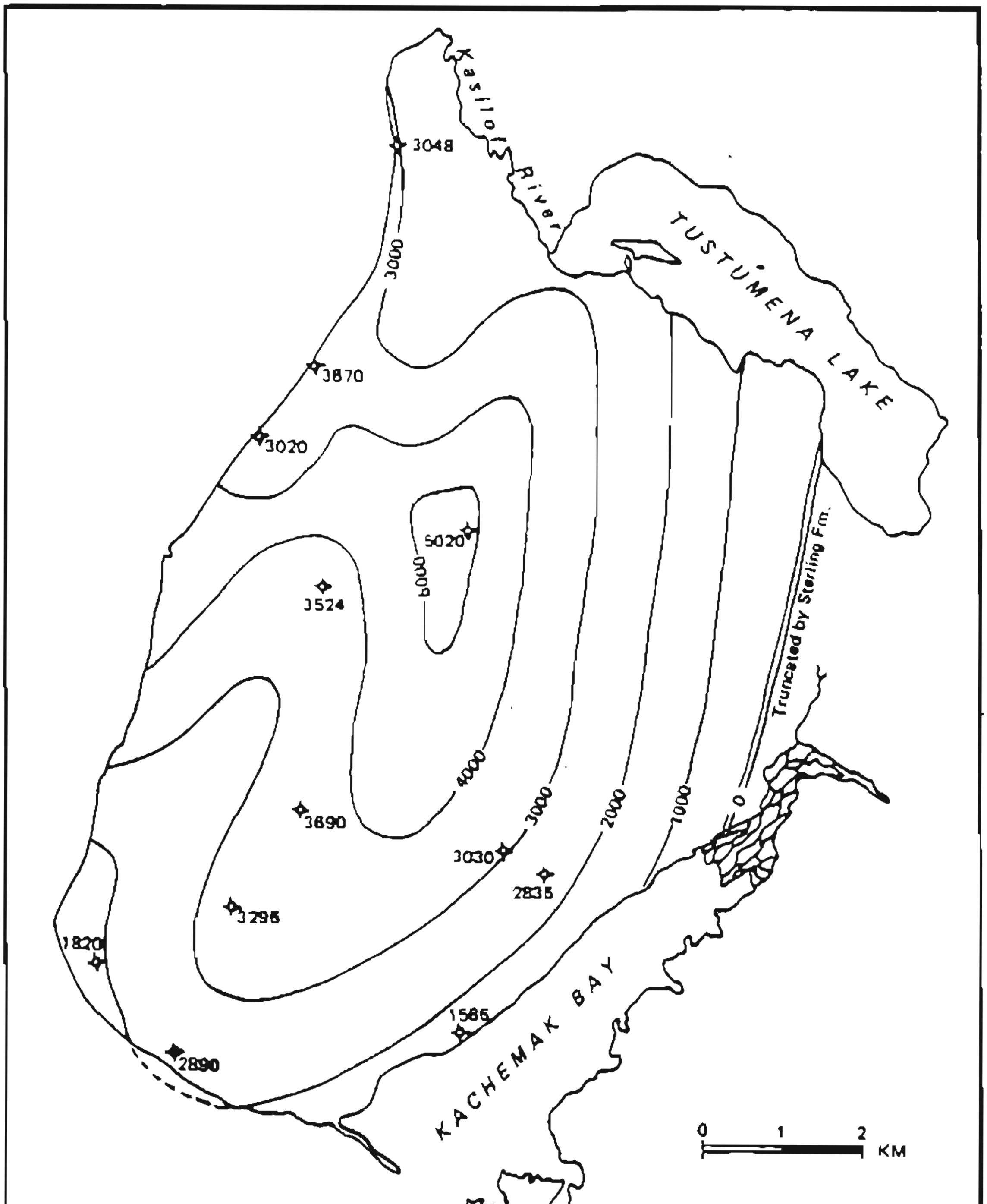

Figure 9. Isopach map of the Beluga Formation, southern Kenai Peninsula. From Hartman and others, 1972. Contour interval is 1,000 ft.

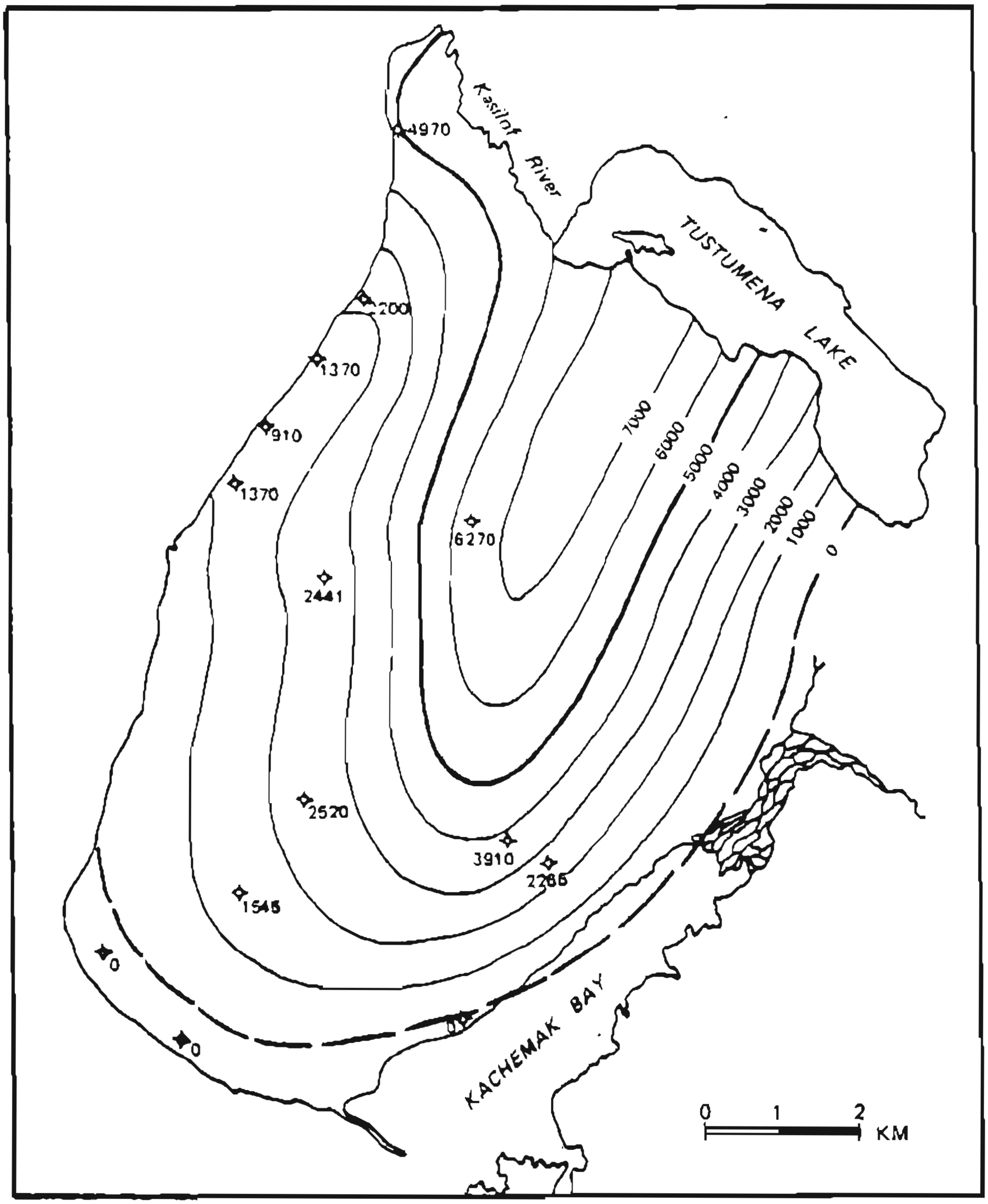

Figure 10. Isopach map of the Sterling Formation plus Quaternary deposits, southern Kenai Peninsula. From Hartman and others, 1972. Contour interval is 1,000 ft.

Figure 11. Large channel sand that has eroded a siltstone bed overlying the bottom coal, the 'G' bed, in the Sterling Formation northeast of Falls Creek on Kachemak Bay. Bottom coal bed is about 1 m thick; note person for scale. Deformation at the top of the channel sand is probably from shearing of soft sediments following deposition. Photograph by D.M. Triplehorn, July 1977.

SYSTEM	SERIES	STAGE	GROUP	FORMATION (THICKNESS)	DESCRIPTION	TYPE SECTION
CENOZOIC	QUAT.			Alluvium and glacial deposits	See Reger (1985) for summary and references	
	UPPER TERTIARY	U. Mio. to Plio. (Clam Gulchian)	KENAI GROUP	STERLING FORMATION (0 - 11,000 ft)	1. Sandstone, massive, with conglomerate, thin lignite. Sandstone 30-90 ft thick with well defined upward fining. 2. Enhanced porosity due to mineral dissolution. 3. Conflicting data on source direction. 4. Montmorillonite; hornblende, hyperthene, enstatite, and epidote 5. Meandering stream environment. 6. Fewer, thinner coal beds than Beluga.	Union Oil Co. of California Sterling Unit No. 25-15 Sec. 15, T5N, R10W, Serward Meridian
		Upper Miocene (Homerian)		BELUGA FORMATION (0 - 6,000 ft)	1. Poorly sorted, thin- to medium-bedded claystone, siltstone, and thin sandstone beds with subbituminous coal beds. 2. Porosity lower than Sterling formation sandstone. 3. Easterly source. 4. Chlorite, biotite, epidote, garnet, zircon, and apatite. 5. Shallow braided streams, wet alluvial fan environment. 6. Coal beds thicker and more abundant than Sterling.	Standard Oil of California Beluga River Unit 212-35(1) Sec. 35, T13N, R10W, Seward Meridian
	L. TERTIARY	Olig. to U. Mio.		TYONEK FORMATION (4,000 - 7,000 ft)	Sandstone, claystone and siltstone interbeds and massive subbituminous coal beds.	Pan American Petroleum Tyonek State 17587 No. 2
		Olig		HEMLOCK CONGLOM. (300 - 900 ft)	Sandstone and conglomerate	Richfield Oil Corporation Swanson River No. 1(34-10)
		Eoc.		WEST FORELAND FM. (300 - 1,000 ft)	Tuffaceous siltstone and claystone. Scattered sandstone and conglomerate beds	Pan American Petroleum West Foreland No. 1
		Kenai Group strata rests unconformably on older Tertiary, Cretaceous, and Jurassic rocks.				

Figure 12. Tertiary stratigraphy of the Cook Inlet basin. Compiled from Calderwood and Fackler (1972), Hayes and others (1976), Fisher and Magoon (1978), and Kremer and Stadnicky (1985).

ordered in the Beluga Formation and well ordered in the Sterling Formation (Hayes and others, 1976). Although the contact between the two formations in their type sections is unconformable (fig. 12), it may be gradational elsewhere.

In the far northwest part of the project area, in the Homer Escarpment, and northeast of McNeil Canyon, the Tertiary strata change northward by decreasing in induration and in quality and rank of coal, and increasing in the proportion of sandstone. Some of these sandstones become very thick toward the north (on the order of tens of meters) and the coal is often dull brown and lignitic rather than shiny black and subbituminous as it generally is in other parts of the section.

Abrupt color changes also relieve the uniformity of the coal-bearing rocks. A change from gray to light brown upsection occurs in the bluffs north of Homer near McNeil Canyon on Kachemak Bay. This color change occurs at coal bed B of Barnes and Cobb (1959; fig. 13), the boundary defined between the Homerian and Clamgulchian floral stages by Wolfe and others (1966). This boundary also approximately marks the contact between the Beluga and Sterling Formations.

Another distinct color change occurs far upsection along the eastern border of the district where the prevailing light-brown rocks of the Sterling Formation give way upward to bluish-gray rocks with similar lithologic texture but they are noticeably deficient in coal. Barnes and Cobb (1950) noted this change in Fox Creek Canyon and thought that it probably occurs along a bedding plane, but could not locate the contact exactly nor confidently tie the bluish-gray beds in Fox Creek Canyon with beds further upsection to the north. This change from light-brown to bluish-gray probably has to do with differences in clay or mafic mineral contents or both caused by a shift in provenance. Figure 14 shows an X-ray diffraction pattern of a typical bluish-gray rock from Fox Creek Canyon. This bluish unit may deserve formal stratigraphic-member status within the Sterling Formation.

Other than the color changes, field observations disclose no obvious interruption in deposition that might mark the Beluga Formation-Sterling Formation contact. However, scouring by overlying sediments shows that coal beds in many cases mark hiatuses (Triplehorn, 1982).

Wolfe and others (1966) defined three new provincial time-stratigraphic rock units based on outcrops along Kachemak Bay and Cook Inlet (fig. 15). The Seldovian, Homerian, and Clamgulchian stages were identified from paleobotanical and palynological evidence along with age determinations. The type and reference sections of two provincial paleobotanical stages are exposed in wave-cut bluffs along the western side of the Kenai Peninsula and the third from the Seldovia Point flora in the Port Graham area. The Beluga Formation generally correlates with the Homerian Stage type section along Kachemak Bay. The Sterling Formation is generally correlative with the Clamgulchian Stage along Kachemak Bay and Cook Inlet.

Wolfe and Tanai (1980) illustrated approximately 60 species of megafossil plants assigned to 45 genera from the Miocene Seldovia Point flora collected

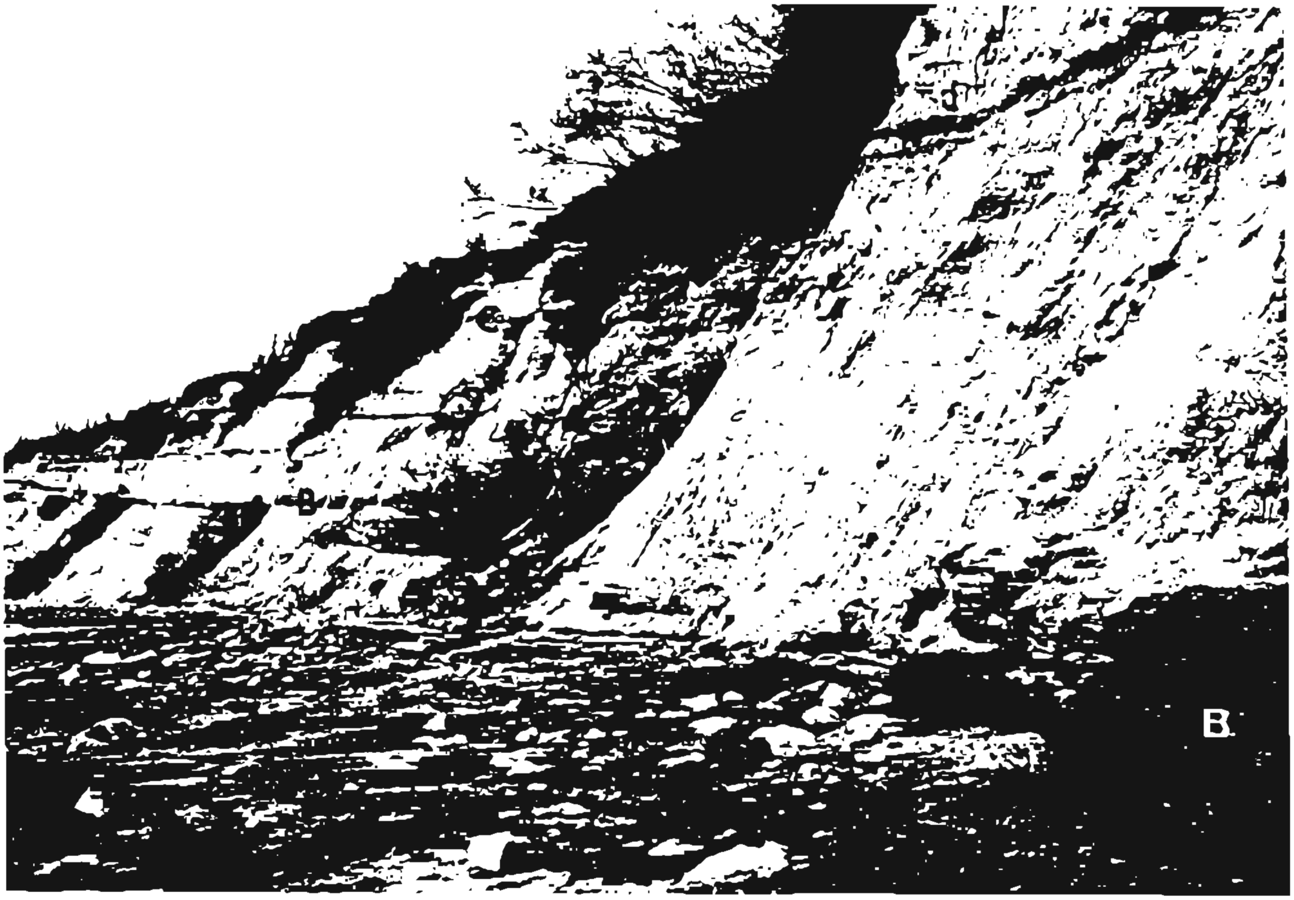

Figure 13. Coal bed B of Barnes and Cobb (1959) at beach level and in mid-section in the distance, northeast of McNeil Creek on Kachemak Bay. The top of this bed was defined by Wolfe (1966) as the boundary between the Homerian (bottom) and Clamgulchian (top) floral stages. Note the sediment color change from gray to light brown at this bed. Photograph by S.E. Rawlinson, June 1986.

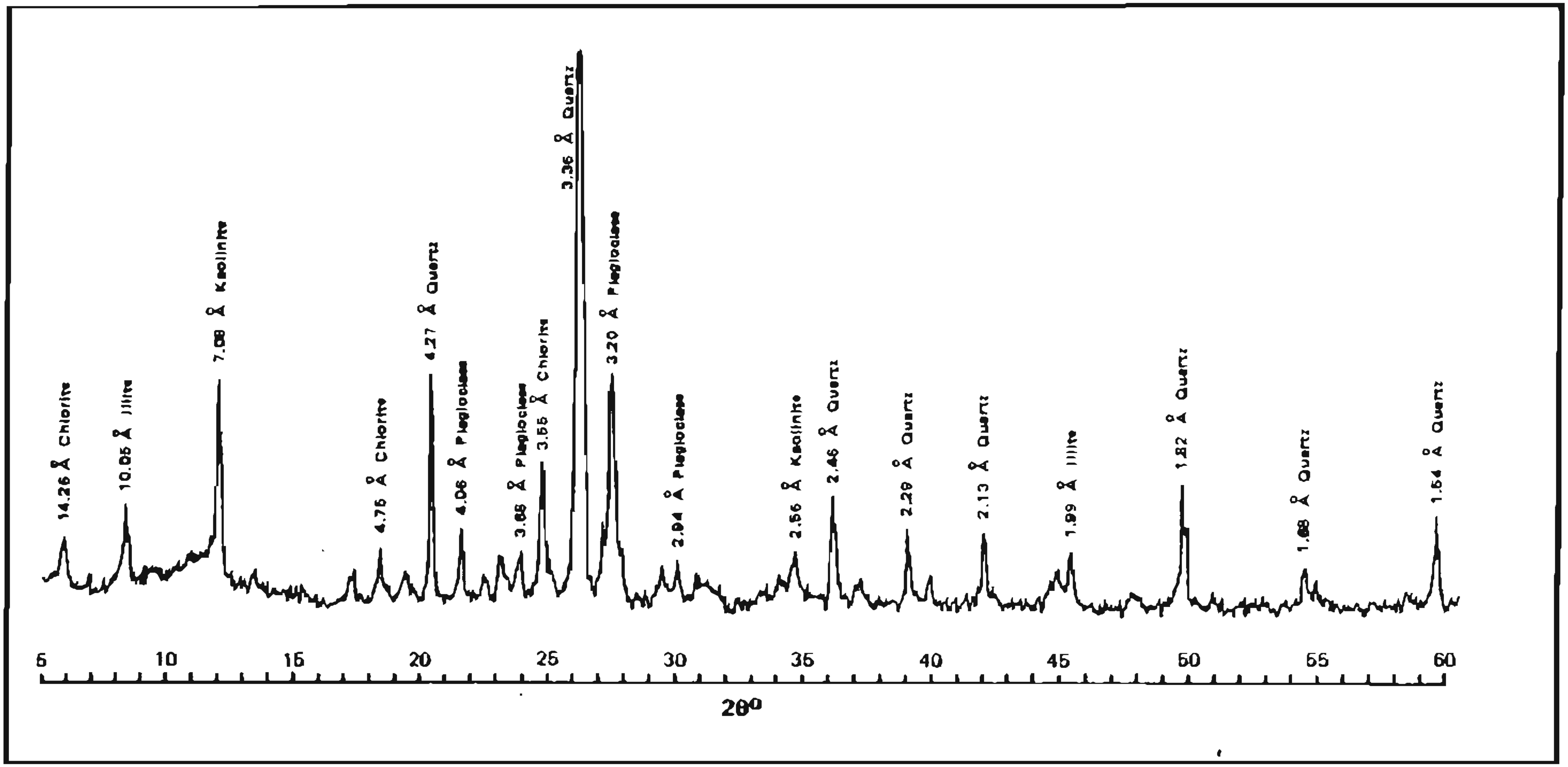

Figure 14. X-ray diffractogram of bluish-gray rock sample from a coal-bearing section in Fox Creek Canyon. It appears that this coloration is due to an increased clay or mafic mineral content.

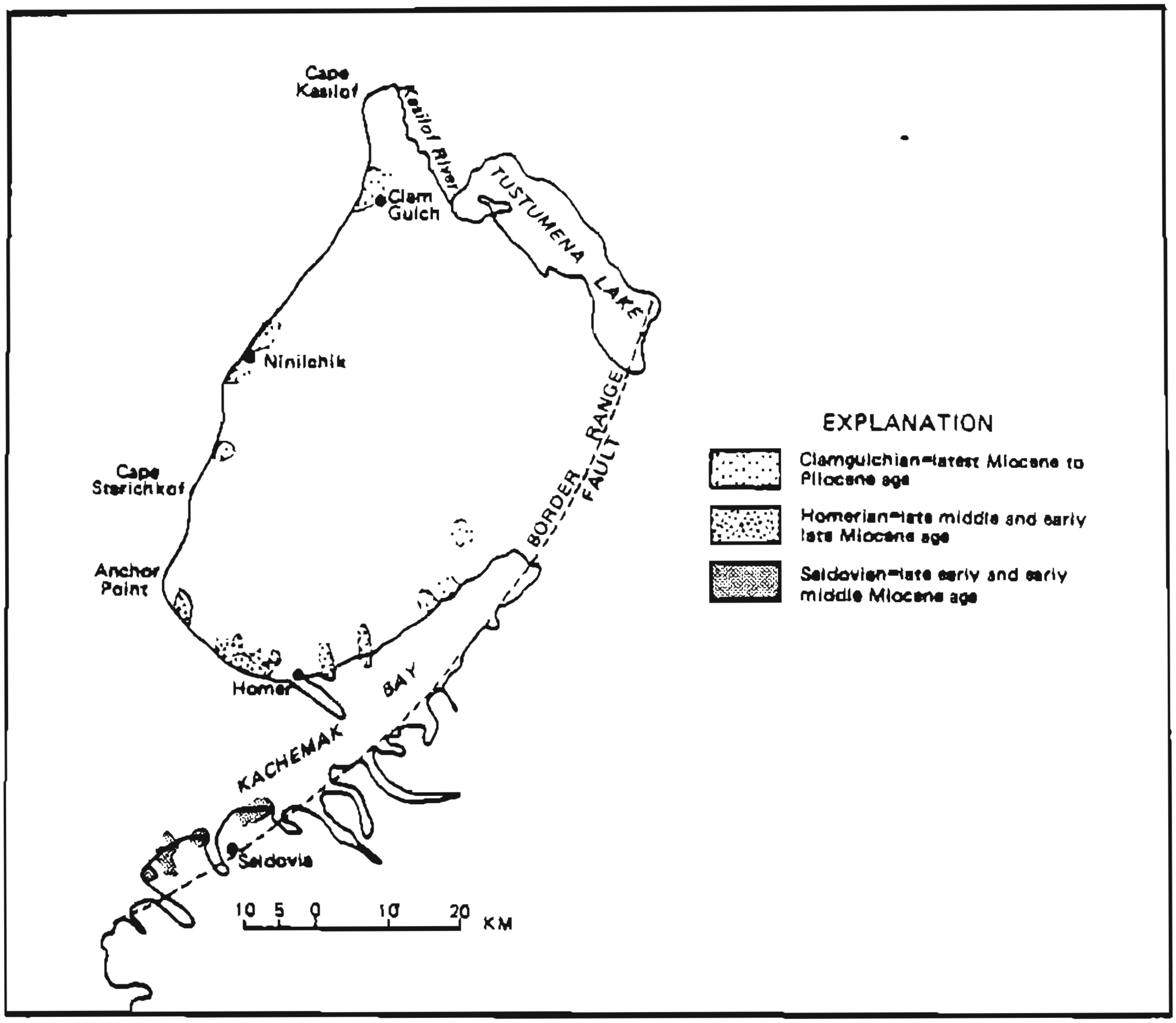

Figure 15. Locations of provincial time-stratigraphic rock units of Wolfe and others (1966), southern Kenai Peninsula.

near Port Graham (fig. 16). Paleobotanical evidence indicates that these plant-bearing beds of late Seldovian age are equivalent to part of the Tyonek Formation. The upper part of the Seldovian Stage correlates with a late early to early middle Miocene age. They conclude that the beds probably represent deposits which filled a valley to the south of the main part of the Kenai basin. They furthermore state that paleoclimatic conditions inferred from the Seldovia Point assemblage strongly indicate that since the middle Miocene there has been a moderate decline in mean annual temperature and a major decrease in mean annual range of temperature.

Triplehorn and others (1977) established the age of the Homerian Stage-Clamgulchian Stage boundary at about 8 m.y. (late Miocene). Turner and others (1980) found that new K-Ar and fission-track ages from volcanic ash partings in coal beds of the Kenai Peninsula substantiated an 8-m.y. age for the Homerian Stage-Clamgulchian Stage boundary. They furthermore stated that the Clamgulchian Stage spans an interval of at least 3.3 m.y. Triplehorn and Turner (1980) suggested an age for the Homerian Stage-Seldovian Stage boundary between 11 and 16 m.y. Wolfe and Tanai (1980) estimate an age of 13-14 m.y. for this boundary.

Because of rapid lateral facies changes and lack of marine fossils and other tools, widespread correlation has not been feasible in Kenai Group coal-bearing rocks of the Homer district, southern Kenai lowland. Gross lithologic characteristics, such as the relatively thick coals in the Beluga Formation, are the only guide (Hite, 1976). The stratigraphy of Adkison and others (1975) needs to be better correlated with the rocks along the eastern shore of Cook Inlet and Kachemak Bay. Rawlinson (1984) did not definitely correlate his measured section with the southwestern and northeastern stratigraphic sections of Barnes and Cobb (1959) or with the stratigraphy of Adkison and others (1975). One objective of stratigraphic correlation studies in the district has been the identification of possible time lines tying rock packages across the southern Kenai lowland from the west side to east side Sterling Formation. Figure 17 shows approximate correlations of stratigraphic sections form southern Kenai Peninsula outcrops.

Each formation of the Kenai Group has a distinctive heavy mineral suite that may be used for correlation purposes (Hite, 1976). The Beluga Formation heavy mineral assemblage is dominated by garnet, zircon, apatite, rutile, and tourmaline (Hayes and others, 1976). The Sterling Formation heavy mineral assemblage is dominated by hornblende and hypersthene (Hayes and others, 1976).

Both in the canyons at the head of Kachemak Bay and north of Clam Gulch, the bluish-gray beds contain laterally continuous volcanic-ash partings, some of which can be traced for several miles. These distinctive ash layers and other marker beds were used in the field to make tentative correlations between stratigraphic sections measured by Barnes and Cobb (1959) in Fox Creek Canyon.

Provenance and Depositional Environments

The Beluga Formation was derived from the metasedimentary terrane of the Kenai-Chugach Mountains east of Cook Inlet basin with transport directions

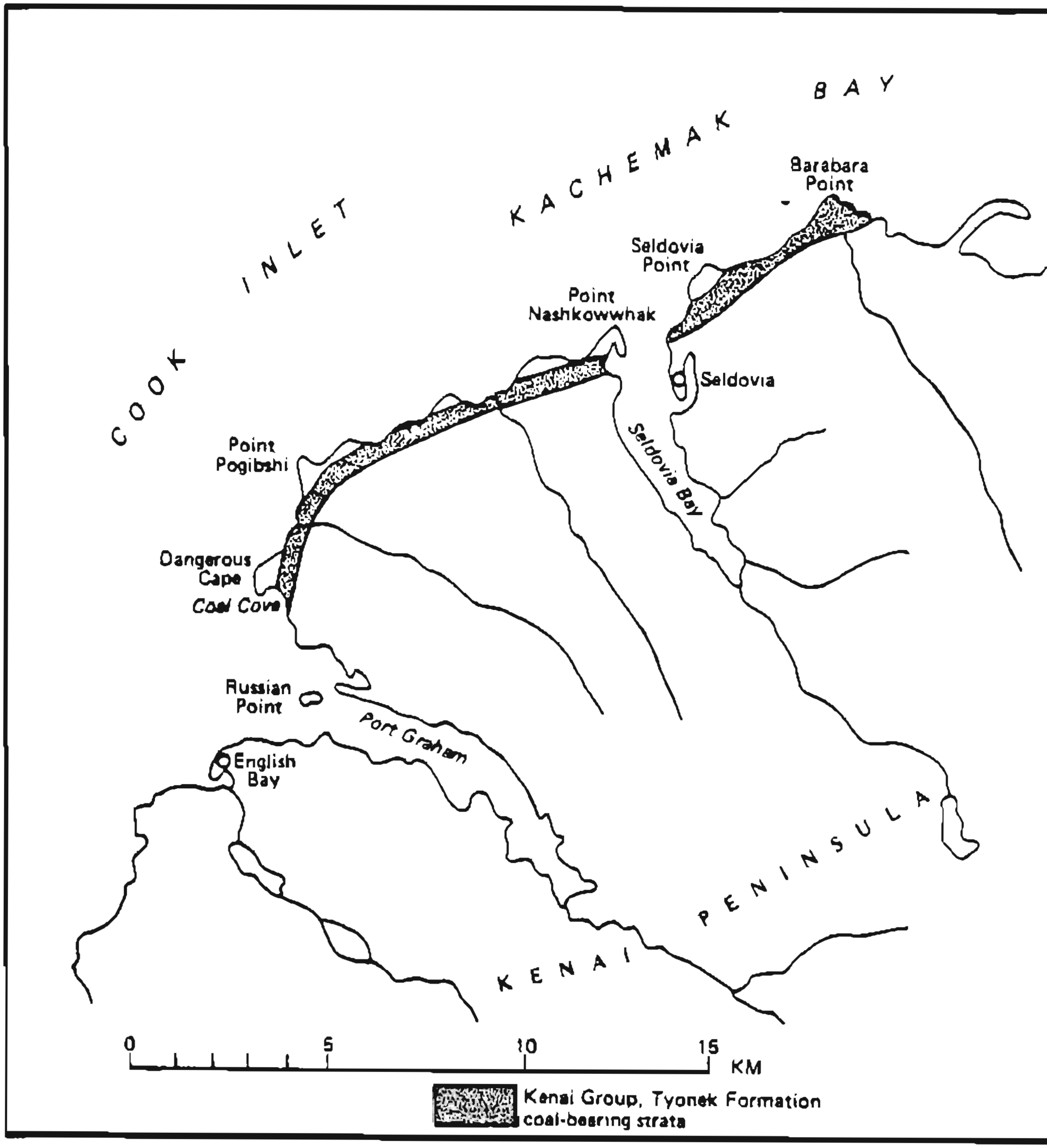

Figure 16. Map of Seldovia area showing the general locations of Tyonek Formation, Kenai Group outcrops (stippled) and Port Graham, site of the first coal mine developed in Alaska. Modified from Wolfe and Tanai, 1980.

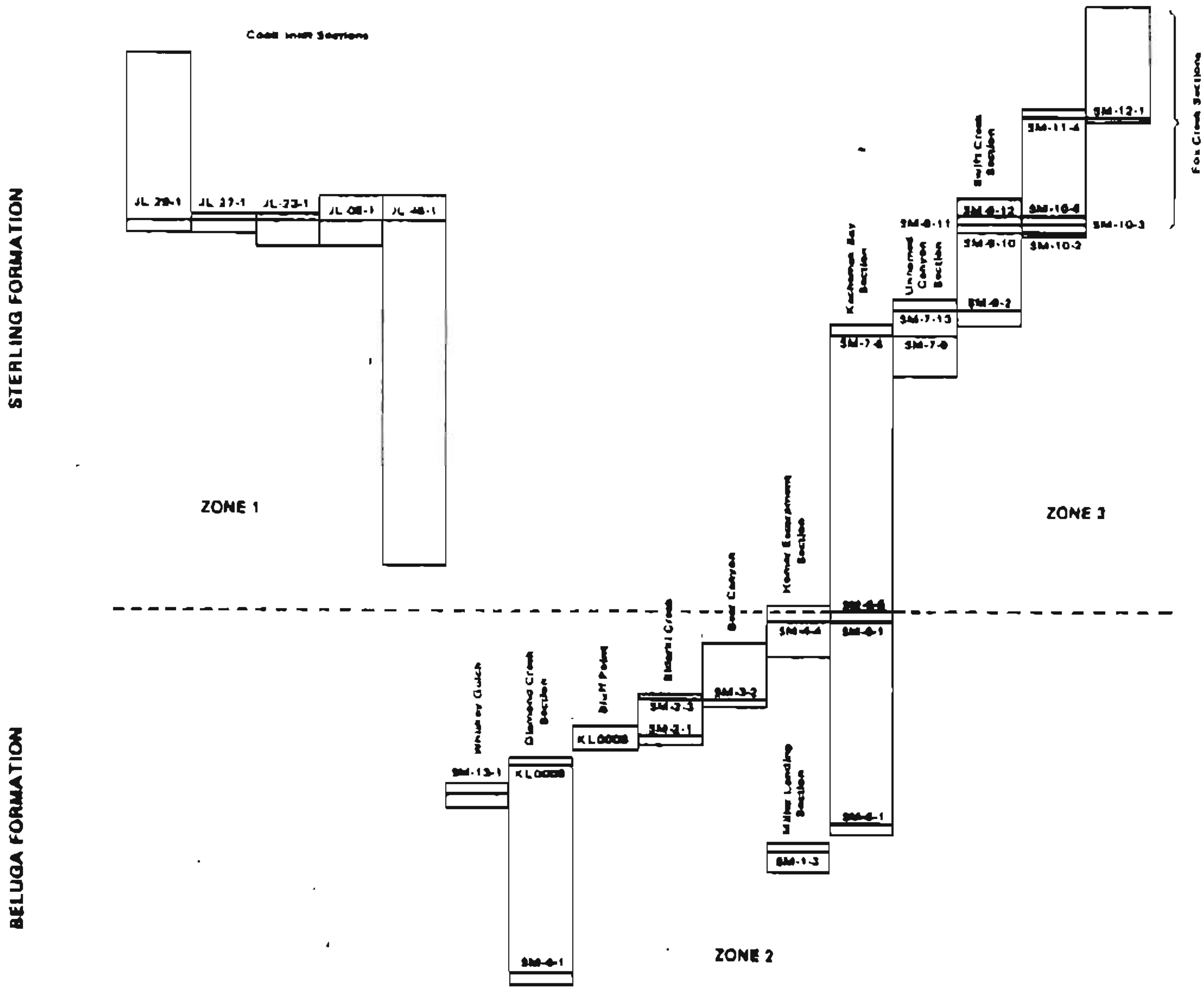

Figure 17. Current conceptual interpretation of how various coal-bearing sections of the Beluga and Sterling Formations on the southern Kenai Peninsula may correlate with one another based on recent field work and previous stratigraphic investigations. These tentative correlations will require further refinement in future studies.

dominantly southwest to south (Hayes and others, 1976). Erosion of these uplifted mountains supplied conglomeratic sediments to a developing basin in the Deep Creek and Sterling areas (Hartman and others, 1972).

The Sterling Formation was derived from the volcanic-plutonic terrane of Aleutian-Alaska Ranges west and north of Cook Inlet with dominant transport directions south and southeast (Hayes and others, 1976). These mountains were uplifted strongly in the late Tertiary becoming major sources of sediment (Hartman and others, 1972).

Rocks of the Beluga and Sterling Formations were deposited near sea level by fluvial processes. Their nonmarine, continental-fluvial origin is based on the nature of beds, absence of marine fossils, presence of abundant coals, and the coarse nature of the clastic assemblage (Hite, 1976).

The Beluga Formation was deposited by relatively small, high-gradient, shallow, braided streams on broad alluvial fans and plains (fig. 18). The braided streams produced lenticular, braid-bar sandstones only a few meters thick (Hayes and others, 1976).

The Sterling Formation was deposited by moderately large, meandering streams which produced 10- to 15-m thick point-bar sandstones (fig. 19). These meandering streams were in belts several kilometers wide on broad plains (Hayes and others, 1976).

CURRENT INVESTIGATION OF PROJECT AREA

Project Description

A coal-assessment project on the southern lowland of the Kenai Peninsula was initiated in the spring of 1986 by the Alaska Division of Geological and Geophysical Surveys (DGGS) in cooperation with the U.S. Geological Survey (USGS). The project was administered through COGEOMAP, a program designed to share USGS funds with state geological surveys to assist with geological mapping and related investigations. DGGS received funding from the USGS for field work, analysis of coal and rock samples, and report production, as well as assistance in the field by two USGS geologists. Five DGGS geologists and two University of Alaska geology graduate students participated in the study. This report summarizes the final results of the project.

Previous investigations have left enough unanswered questions about the stratigraphy and structure of the coal-bearing rocks in the southern Kenai lowland to warrant further work at the scale of a COGEOMAP project. In addition, few coal analyses have been reported for this large area. The main purpose of the project has been to fill important data gaps.

Field investigation and laboratory research phases included: 1) measuring and describing the coals and other sedimentary rocks to refine and complete previous attempts at correlation; 2) collecting valuable baseline data on coals and overburdens; 3) determining and improving surface contacts between the late Miocene Beluga Formation and the late Miocene to Pliocene Sterling Formation, the two defined stratigraphic bedrock units in the project area;

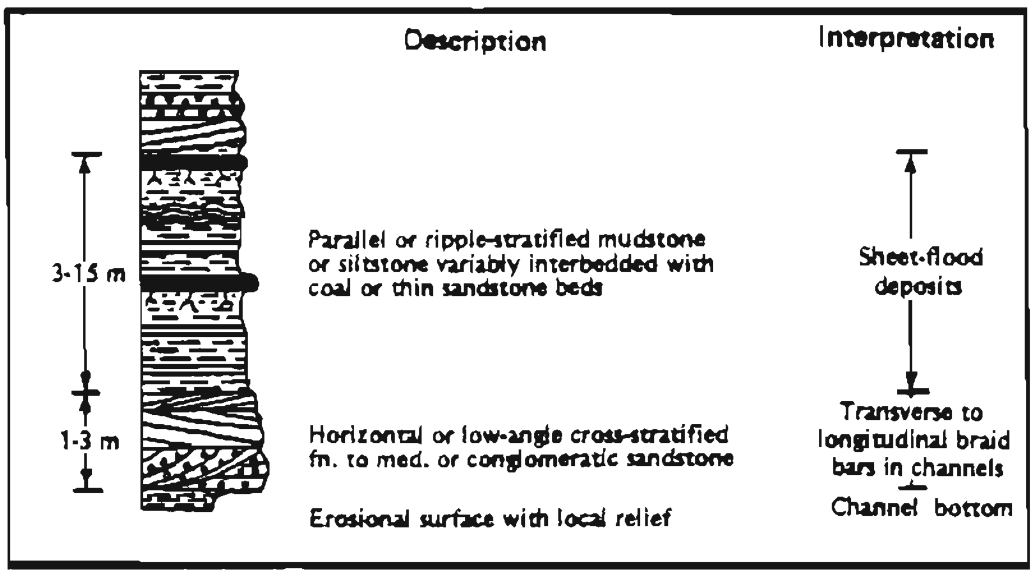

Figure 18. Typical Beluga Formation lithologies, sedimentary structures, and depositional environments. From Hayes and others, 1976.

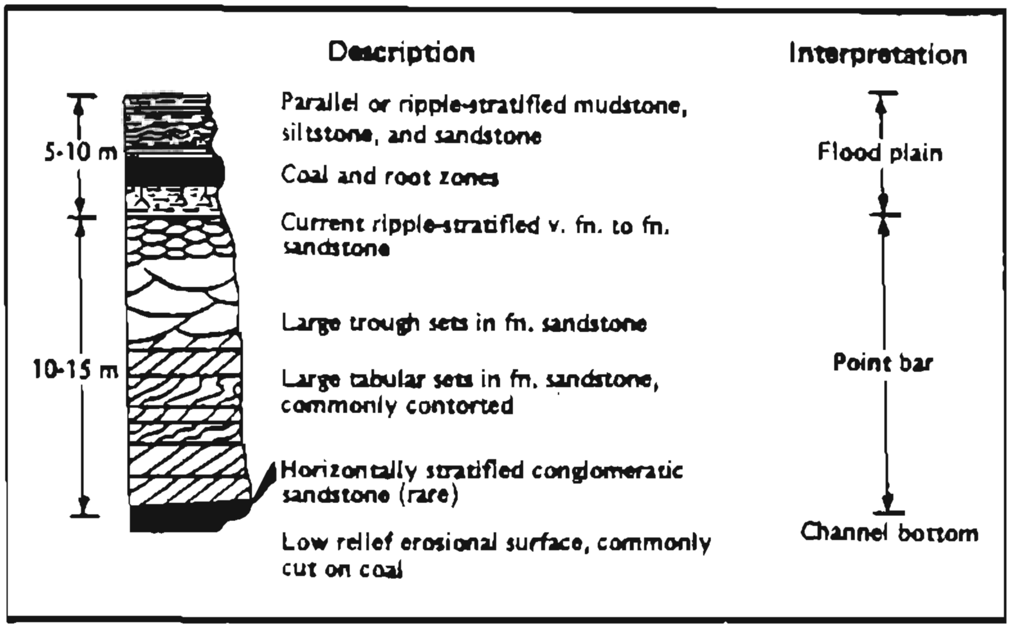

Figure 19. Typical Sterling Formation ordered vertical sequence of lithologies and sedimentary structures. From Hayes and others, 1976.

4) collecting paleontological and lithological samples to help distinguish units; 5) studying volcanic-ash partings in the area in hopes of establishing some distinctive, widespread marker beds; 6) collecting and integrating unpublished borehole data with previously reported information and our own results; and 7) planning diamond-drill coring, with electric logs, in critical areas in anticipation of possible future funding. The results of this work follow and have produced an improved synthesis of the geology of the southern Kenai lowland.

Field Work

In June 1986, three teams of two geologists worked for sixteen days to measure, describe and sample rocks and coals in the project area. One team measured and sampled a continuous section from about 2 mi north of Clam Gulch southward to Cape Starichkof, where a mostly covered interval about 6 mi long begins. The other two teams started with better stratigraphic information and mainly addressed gaps in correlation and sampling southeastward from Anchor Point and north and northeastward from Homer.

In addition to measuring thousands of feet of section, especially on the Cook Inlet coast, we collected numerous leaf fossils, overburden (carbonaceous shale, claystone, and siltstone) samples that we expect contain Tertiary pollen, lithologic samples for clay and heavy-mineral analysis, and samples of volcanic-ash partings. We anticipate that a combination of various distinguishing criteria, when applied to all of our stratigraphic and sample data, will help to refine the Beluga Formation-Sterling Formation contact in outcrop.

Photo-mosaics

Continuous, overlapping, low-angle 35-mm photographs of the bedrock exposed in the seacliffs along Cook Inlet and Kachemak Bay were made in late May 1986 (fig. 20). Low-altitude, oblique photographs were made using helicopter-supported, hand-held camera equipment. The photographs, done simultaneously in black and white prints and color slides, provide a nearly complete pictoral record of the formations along more than 50 mi of coast and can be assembled into a continuous mosaic for any desired stretch. Approximately seven frames were taken per mile of beachcrop, representing a horizontal scale of about 750 ft per photograph.

The photos were used effectively for planning field work, as a base for locating and plotting sample locations in the field, for studying bedding and structural features, and for resolving correlation problems. The negatives and slides have been permanently stored for public use as an Alaska Division of Geological and Geophysical Surveys (Fairbanks) Public-data File report.

Sampling

Over 140 channel samples were collected from exposed coal beds in the southern Kenai lowland (table A1, appendix A). These include at least one sample from every coal bed 2-ft or greater in thickness, numerous thinner beds in relatively barren stretches, and several multiple samples across faults and covered intervals.

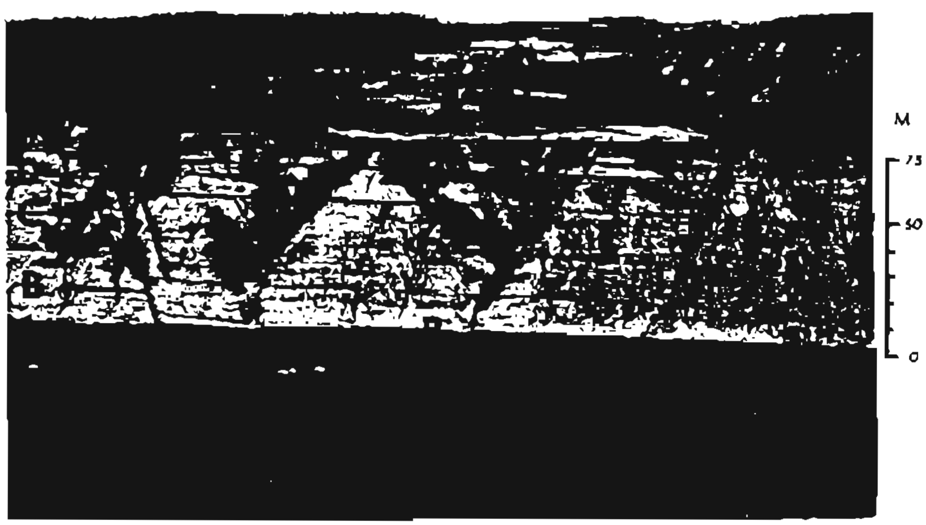

Figure 20. Example of low-altitude, oblique photograph of Kachemak Bay Sterling Formation coal-bearing beachcrop. High-angle normal fault displaces coal beds B, C, and D at left. Horizontal scale is approximately 750 ft.

Project-area Subdivisions

The project area has been divided into three provisional zones to group and simplify the analytical data for display (fig. 21). These zones are: 1) Cook Inlet (west side) Sterling Formation coals; 2) Kachemak Bay (south side) Beluga Formation coals; and 3) Kachemak Bay (east side) Sterling Formation coals. Discussion of results of coal petrologic and quality investigations in later sections of this report will be based on division of samples into groups assigned to these zones.

Sheet Maps

This report is accompanied by 14 sheets (in pockets). Sheet 1 illustrates the regional geology of the Homer district, including major structural features. In addition, inch: mile (1:63,360) quadrangle subdivisions of Kenai and Seldovia 1:250,000 quadrangles are shown in a generalized index. Oil and gas wells are indicated for location purposes.

The detailed geology and structure of each of the inch: mile quadrangles are depicted on sheets 2 through 10. Kenai 1:63,360-scale quadrangle maps include B-4 (sheet 2), A-4 (sheet 3), and A-5 (sheet 4). Seldovia 1:63,360 quadrangle maps include D-5 (sheet 5), D-4 (sheet 6), D-3 (sheet 7), C-4 (sheet 8), C-5 (sheet 9), and parts of B-5 and B-6 (sheet 10). In order to effectively show details along coastal beachcrops, insets were prepared for Kenai A-5 (sheet 4) and Seldovia C-4 (sheet 8) Quadrangles. The detailed inch: mile maps show the locations of all samples---coal, overburden, sandstone, palynology, and plant fossils. Locations of all measured sections and boreholes (for coal, oil or gas) are also displayed.

Three correlated stratigraphic sections representing the Kachemak Bay Sterling Formation (sheet 11), Kachemak Bay Beluga Formation (sheet 12), and Cook Inlet Sterling Formation (sheet 13) summmarize regional stratigraphy. Individual samples are annotated on the columns. Explanation and symbol information for all maps are listed on sheet 14.

RESULTS OF PROJECT AREA INVESTIGATION

Sandstone Mineralogy

The most obvious difference between Beluga Formation and Sterling Formation sandstones is the percentage of volcanic vs. lithic grains (table 1; table C1, app. C). The Sterling Formation has a much higher percentage of volcanic rock fragments and plagioclase than the Beluga Formation, which contains predominantly lithic fragments.

The abundance of volcanic rock fragments and plagioclase in the Sterling Formation indicates a volcanic or hypabyssal origin. The Sterling Formation sands were probably derived mainly from the western side of Cook Inlet where Pliocene volcanic activity was occurring. The untwinned plagioclase is almost exclusively zoned in the sandstones, and is another indication of volcanic or hypabyssal origin. The heavy minerals hornblende and hypersthene also show an increased abundance in Sterling Formation sands.

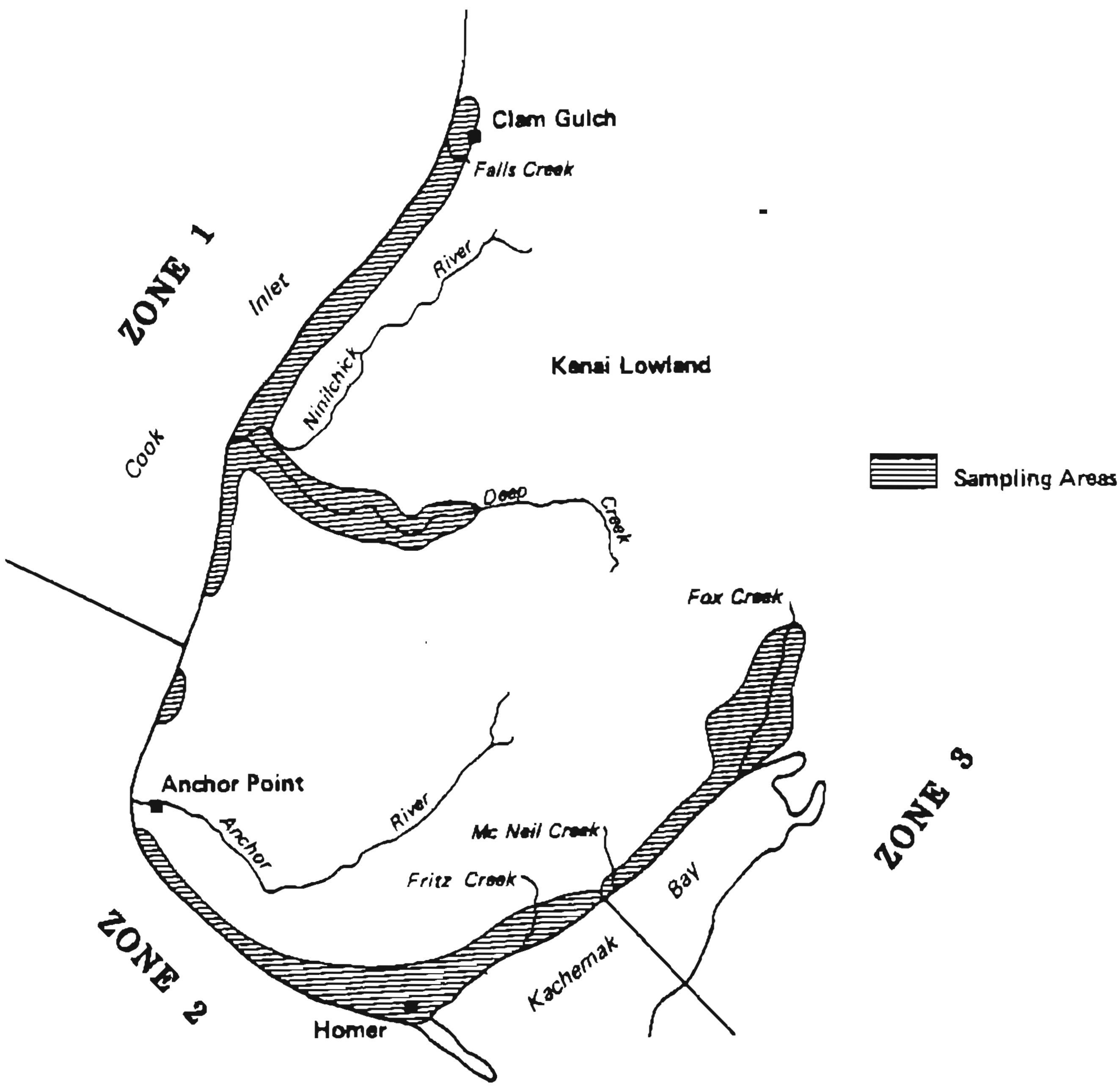

Figure 21. Provisional zones used for grouping and simplification of analytical data for display. Zone 1 is Cook Inlet (west side) Sterling Formation coals; zone 2 is Kachemak Bay (south side) Beluga Formation coals; and zone 3 is Kachemak Bay (east side) Sterling Formation coals.

Table 1. Average modal analysis (%) of southern Kenai Peninsula sandstone samples. The number of samples analyzed is indicated in parentheses.

Detrital grains	Cook Inlet Sterling Formation (8)	Kachemak Bay Beluga Formation (6)	Kachemak Bay Sterling Formation (11)
Undulose quartz	17.6	15.7	22.8
Non-undulose quartz	4.7	4.9	5.4
Polycrystalline quartz	9.3	14.3	7.0
Potassium feldspar	5.8	4.6	4.0
Altered feldspar	4.5	2.5	1.5
Plutonic rock fragment (K-spar)	1.7	1.7	1.7
Plutonic rock fragment (quartz)	1.9	1.6	2.0
Twinned or zoned plagioclase	4.2	2.8	3.4
Untwinned plagioclase	11.4	4.0	6.1
Quartz-mica schist/gneiss	1.0	3.8	3.0
Quartz-mica phyllite	1.7	5.2	3.0
Chert	1.3	4.2	1.9
Cherty argillite	4.7	8.4	6.8
Argillite	1.5	2.6	2.7
Siltstone	1.3	4.0	1.3
Slate/shale	1.2	5.0	2.6
Sandstone	2.4	7.2	3.1
Volcanic rock fragment or glass	16.3	4.9	12.7
Biotite	1.0	0.3	1.4
Hornblende	3.1	0.4	1.2
Clinopyroxene	1.5	0.2	1.1
Epidote	0.5	0.6	0.1
White-mica sericite	0.2	0.5	1.1
Coal/organics	0.6	0.6	2.8
Zircon	0.2	0.0	0.4
Rutile	0.04	0.0	0.3
Chlorite	0.9	0.6	1.1
Carbonate	0.0	0.4	0.1
Total	100.54	101.00	100.6

The lithic character of the Beluga Formation is evident due to the increase in lithic grains---polycrystalline quartz, schist and phyllite fragments, chert, cherty argillite, argillite, siltstone and sandstone fragments. The high lithic content of the Beluga Formation indicates a metamorphic provenance most likely from rocks of the Chugach Range east of the Kenai coal field. Volcanic grains and heavy minerals like hornblende and hypersthene show depleted percentages. Epidote, typically of metamorphic genesis, shows a slight increase in the Beluga Formation.

The volcanic character of the Sterling Formation decreases upsection. In areas with abundant woody coal as near Ninilchik and in the uppermost reaches of Fox Creek Canyon immediately below the bluish-gray beds, volcanic fragments are greatly reduced. Samples of sands low in volcanic fragments include 86JL18-2, 86JL44-1, 86SM09-14, and 86SM12-2. The bluish-gray sandstones at the extreme top of the Sterling Formation are lithic-rich like Beluga Formation sands. Volcanic grains are almost nonexistent here, but chlorite content is increased. The combination of the chlorite and lithic grains may be the reason for the bluish-gray color of the beds. A change in provenance is probably indicated in these sandstones.

The potassium feldspar content of the Kenai Peninsula sandstones decreases eastward in the Homer district. Samples of sands taken near the Sterling Formation/Beluga Formation contact on the Cook Inlet (samples 86JL35-1 and 86SM13-2) and Kachemak Bay (sample 86SM06-4) sides of the peninsula are gradational and show intermediate percentages of detrital grains. Homer Escarpment sands are more similar to those of the Sterling Formation even though the contact is nearby.

Palynological Analysis

Rock samples from the Beluga and Sterling Formations of the southern Kenai Peninsula were collected for palynological analysis. These samples are listed in table A3 of appendix A. Examinations of the fossil pollen and spore assemblages in the samples are currently in progress by Thomas Ager, geologist with the U.S. Geological Survey, Reston, Virginia. Results of the analysis will be made available in the future as part of an encompassing study of Alaska Tertiary floras.

Volcanic Ash Partings

Abundance and Composition

Altered volcanic ash partings are more common than detrital partings in Tertiary coal seams along the shores of the southern Kenai Peninsula (figs. 22 and 23). (Partings are non-organic layers in coal generally from 1-10 cm thick.) Volcanic ash partings are distinguished in the field from detrital partings mainly by their pinkish hues, homogeneous appearance, and white weathering. Detrital partings have a grayish color and a heterogeneous appearance.

Figure 22. Gully (right) in Fox Creek where about 209 m of exposed Sterling Formation strata was measured; light colored bed in the approximate middle of the section is predominantly volcanic ash (va). Photograph by S.E. Rawlinson, June 1986.

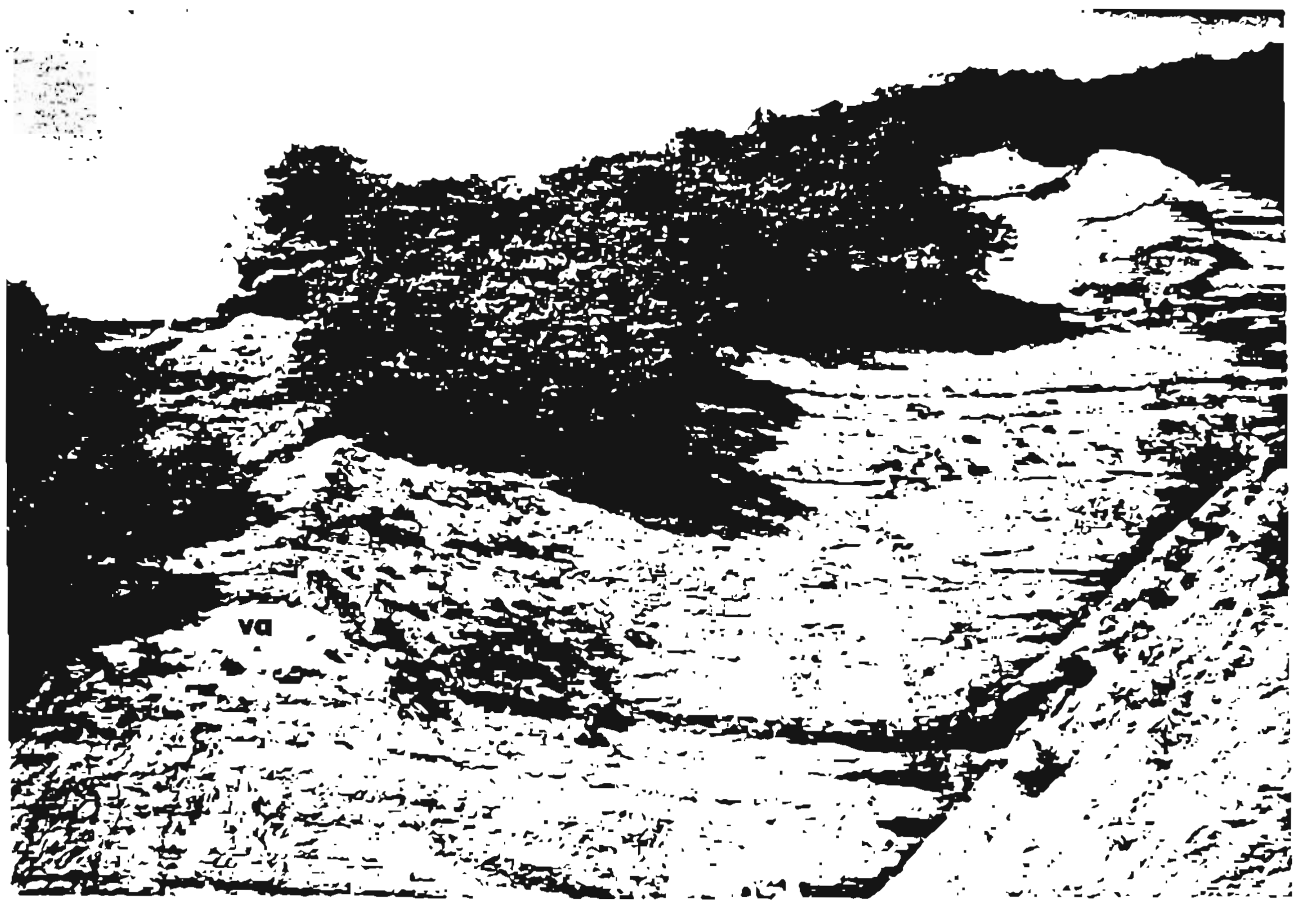

Figure 23. Close-up view of 2.3-m thick volcanic ash (va) bed in the Sterling Formation of Fox Creek Canyon. Coal bed that crops out in the gap between the trees on the horizon also includes an ash parting. Photograph by S.E. Rawlinson, July 1977.

One hundred partings have been sampled and analyzed by X-ray, chemical, and petrographic methods. From the less 2 micron clay fraction, it has been determined that the volcanic ash partings always contain smectite and frequently kaolinite. Bulk and X-ray powder diffractograms show the presence of siderite, rare plumbogummite minerals as well as common quartz and feldspar. The Fox Creek, McNeil Canyon and Ninilchik-Clam Gulch areas are characterized by the presence of volcanic glass, minor halloysite, and quartz and feldspar, respectively. Most partings designated as volcanic contain one or more minerals characteristic of volcanic origin, as well as volcanic glass in various stages of devitrification and transition to clay. The altered glass can be recognized by its morphological features. Detrital partings, on the other hand, contain illite, chlorite, kaolinite, and physical mixtures of illite-smectite.

SiO_2 concentrations are highest in the younger partings and lowest in the older partings. Al_2O_3 shows an opposite trend. Detrital partings are characterized by a high Fe_2O_3 content, which can be attributed to common siderite. Low titanium/aluminum ratios of 0.03-0.04 are indicative of rhyolitic source volcanics for the ash partings. Trace-element concentrations of the younger partings are near their original content, but some depletion and some enrichment has occurred in the older partings.

Cluster analysis using major oxide and trace element data show that volcanic ash partings from McNeil Canyon and Fox Creek may correlate with partings from Ninilchik and Clam Gulch areas.

Significance

Evidence from the Angoonian period in the Cook Inlet region shows that the volcanic ashes, for the most part, were destroyed by being deposited in a marine environment. The frequency of volcanic eruptions (now partings) appears to have been low. The partings are fairly thin but not necessarily fine-grained. Either the volcanic vents were not in near proximity or the volcanic eruptions were short lived.

By the Homerian period, volcanic activity appears to have increased dramatically in the Cook Inlet region. Although it appears that volcanism was sometimes weak, it was nevertheless continuous. The tectonic setting was relatively unstable with constant small-scale base level changes resulting from increased subsidence of the region. The coal seams are fairly thin and contain as many clastic as volcanic partings. The ash partings are thin (10 cm maximum thickness) but numerous. Upon close examination of the coal, visible pumice fragments can be seen disseminated throughout it. Some of the partings are coarse-grained, but the majority are fine-grained and altered.

With the Clamgulchian period, volcanism had eased in the Cook Inlet region and separate volcanic events can be recognized as individual pulses of activity. Volcanic eruptions appear to have been spaced over longer periods of time, perhaps indicating sources in close proximity to depositional sites. Coal seams formed at this time are thicker than those formed during the Homerian period. Ash partings are fewer in number but thicker, especially in the late Pliocene. Partings are generally well-defined and coals are cleaner overall.

Coal Petrology

Methods of Analysis

Maceral Analysis

For analyzing the petrology of Kenai Peninsula coals, a Leitz orthoplan microscope was used. For maceral determinations, 500 counts were made of vitrinitic and inertinitic macerals under normal incident light. Liptinitic macerals, carbomineralites, and epoxy were omitted during this quantitative analysis phase. Subsequently, the liptinitic macerals were counted using blue-light excitation. In total, 100 samples were analyzed for petrology.

Microlithotype Analysis

Microlithotypes are groupings of macerals in a microscopic field of view. Macerals rarely occur singly but are usually associated with macerals of the same or the other two maceral groups in microlithotypes that are classed as mono-, bi-, or trimaceralic. Microlithotype analysis has proven to be useful in determining environments of deposition and can be valuable in seam correlation.

Microlithotypes were analyzed and point-counted in the polished coal pellets using a 20-point graticule; 500 counts were made on each pellet under normal incident light. Difficult identifications were cross-checked for accuracy under fluorescent light. In total, 100 coal-pellet samples were read for microlithotype analysis.

Vitrinite Reflectance Analysis

Maximum reflectance measurements were made in oil on 100 coal-pellet samples with 50 readings made on each. The polished pellets were dried in a desiccator prior to examination. A filter was used to give peak transmittance at 546 nanometers wavelength. Bausch and Lomb optical glasses were used as reflectance standards.

Results of Petrologic Analysis

Maceral Analysis

Coals of the Beluga Formation on the southern Kenai Peninsula are blocky in appearance, similar to Nenana basin coals. They are mostly dull with vitrain bands scattered throughout. A substantial amount of macroscopic amber can be observed in hand-specimens, blocks, and polished sections of Beluga Formation coals in the Homer and Anchor Point areas. Coals in the Sterling Formation become more woody upsection. These woody coals are most common in the vicinity of Ninilchik and Clam Gulch, where younger rocks of synclinal structures are exposed.

Vitrinite content, representing the woody parts of trees, is relatively constant in both the Beluga and Sterling Formations (table 2). Pseudovitrinite is relatively rare in the low-rank coals of the southern Kenai Peninsula. Phlobaphinites and porigelinites are slightly more common in the Sterling Formation than in the Beluga Formation, whereas pseudophlobaphinites are marginally more common in the Beluga Formation. The vitrinites in Beluga Formation coals are mainly ulminite with remanent pore structure relatively rare. However, remanent pore structure increases upsection, and this is evidenced in the Sterling Formation by higher contents of texto-ulminite and textinite.

The older, higher-quality coals of the Beluga Formation are richer in liptinites (the maceral group including spores, waxes, fats, and oils of precursor coal-forming plants) than the younger, lower-quality coals of the Sterling Formation (table 2). Although possibly random, this could indicate a different type of vegetation, perhaps with a higher proportion of gymnosperms than is present in younger Sterling Formation coals. The liptinites in Beluga Formation coals mostly occur as sporinite and resinite. Alginite is extremely rare in these coals. Exsudatinite was observed in Beluga Formation coals but was of only minor occurrence. This indicates that the coals had reached a level of coalification wherein the resinites had just started to migrate. The Sterling Formation contains more suberinite than the Beluga Formation.

Beluga Formation coals are very low in inertinites (table 2). Sterling Formation coals have the highest inertinite contents, including greater abundances of each individual inertinite maceral. Of the inertinites, semifusinite and inertodetrinite are the most common with sclerotinite, fusinite, and macrinite occurring in decreasing abundance. The fact that semifusinite, inertodetrinite, and sclerotinite occur in greater abundance than the other inertinites indicates that low-water levels and associated peat degradation from oxidation were chiefly responsible for their formation. A fluctuating water table may have produced oxidizing conditions or a drier climate may have produced forest fires.

Two relative prominent bands with increased levels of inertinites occur in the Kachemak Bay Sterling Formation coals and one in the Cook Inlet side Sterling Formation coals. The latter is repeated several times due to folding. Although one coal on the Cook Inlet side revealed a maximum 23 percent inertinite content, the bands average only about 10 percent inertinite. These high inertinite bands evidently represent dry periods during the deposition of Sterling Formation coals. It is at least possible that the upper band present in Swift Creek and lower Fox Creek is age-correlative to the one on the Cook Inlet side. In addition, vitrinite reflectances for these coals are similarly low.

Microlithotype Analysis

The five most common microlithotype varieties in southern Kenai Peninsula coals (table 3) are vitrite (100 percent vitrinite), clarite (vitrinite + liptinite), vitrinertite (vitrinite + inertinite), duroclarite (a trimacerite with all three major groups), and carbomineralites (mineral grains, predominantly carbargilite; table 4). Minor inertite (100 percent inertinites)

Table 2. Summary of maceral analysis for coals of the Beluga and Sterling Formations, southern Kenai Peninsula. For comparison, Sterling Formation coals have been divided into two groups---those on Kachemak Bay and Cook Inlet sides of the peninsula.

A. Macerals and maceral types

Sample	Ulminite/ vitrinite	Pseudo- vitrinite	Phloba- phinite	Pseudophlo- baphinite	Porigeli- nite	Spori- nite	Resi- nite	Cuti- nite	Algi- nite	Exsuda- tinite	Suberi- nite	Lipto- detrinite	Macri- nite	Fusi- nite	Semi- fusi- nite	Sclerotl- nite	Inerto- detrinite
Sterling Formation, Cook Inlet	81.7	0.0	1.7	1.0	0.9	2.2	2.2	0.6	0.0	0.0	1.3	3.3	0.3	0.7	2.2	0.6	1.3
Sterling Formation, Kachemak Bay	82.0	0.0	1.9	0.9	1.0	1.7	2.2	0.6	0.0	0.0	1.8	3.1	0.1	0.6	2.2	0.7	1.2
Beluga Formation, Kachemak Bay	82.1	0.0	1.5	1.1	0.8	2.3	3.3	0.7	0.0	0.1	1.1	3.5	0.1	0.4	1.7	0.5	0.8

B. Maceral group proportions

Samples	Maceral group		
	Huminite	Liptinite	Inertinite
Sterling Formation, Cook Inlet	85.3	9.6	5.1
Sterling Formation, Kachemak Bay	85.8	9.4	4.8
Beluga Formation, Kachemak Bay	85.6	11.0	3.4

Table 3. Summary of microlithotype analysis for coals of the Beluga and Sterling Formations, southern Kenai Peninsula. For comparison, Sterling Formation coals have been divided into two groups---those on Kachemak Bay and Cook Inlet sides of the peninsula.

A. Microlithotypes

Samples	Vitrite	Liptite	Inertite	Durite	Clarite	Vitrinertite	Duro-clarite	Claro-durite	Carbargilite	Carbopyrite	Carbankerite	Carbo-silicite
Sterling Formation, Cook Inlet	61.6	0.0	0.2	0.0	14.9	6.5	3.6	0.0	9.3	0.6	2.9	0.4
Sterling Formation, Kachemak Bay	64.9	0.0	0.2	0.0	13.4	6.4	2.9	0.0	10.0	0.1	1.9	0.2
Beluga Formation, Kachemak Bay	60.5	0.0	0.2	0.0	16.9	4.6	3.1	0.0	12.3	0.7	1.5	0.2

B. Microlithotype groups

Samples	Vitrites	Clarites	Vitrinertites	Trimacerites	Carbominerallites	Other
Sterling Formation, Cook Inlet	61.6	14.9	6.5	3.6	13.2	0.2
Sterling Formation, Kachemak Bay	64.9	13.4	6.4	2.9	12.2	0.2
Beluga Formation, Kachemak Bay	60.5	16.9	4.6	3.1	14.7	0.2

Table 4. Common carbomineralites or coal-mineral associations. Modified from Stach and others, 1982.

Coal intergrown with a certain mineral or a mineral group	Composition
Carbargilite	Coal + 20-60% by volume of clay minerals
Carbopyrite	Coal + 5-20% by volume of sulfide minerals
Carbankerite	Coal + 20-60% by volume of carbonate minerals
Carbosilicite	Coal + 20-60% by volume of quartz

occurs in the high inertinite bands of southern Kenai Peninsula coals, but it is statistically insignificant.

The Beluga Formation coals have less vitrite than Sterling Formation coals (table 3). The higher percentage of vitrites in the upper Sterling Formation coals of the Canyons area, Kachemak Bay, is attributed to the abundant woody beds. The more woody the coal, the higher the vitrite content, and the lower the content of other microlithotypes. The Beluga Formation also contains the most clarite, because liptinites---especially resinite and sporinite---are relatively abundant in this formation. Clarite contains at least one liptinite maceral with the other vitrinite macerals, or a minimum of 5 percent liptinite. Since the Beluga Formation contains little inertinite, it is resultantly also low in vitrinertite. The Sterling Formation has a larger percentage of vitrinertite as a result of the high inertinite bands.

Trimacerite contents increase westward from the Kachemak Bay Sterling Formation coals and Beluga Formation coals to the Cook Inlet side Sterling Formation coals (table 3). The higher trimacerite (predominantly duroclarite) content on the Cook Inlet side is due to the increase in inertinite found in bands. These bands are repeated as the rocks are folded in recurring synclines and anticlines.

Of the carbomineralites, carbargilite (coal + clay minerals) is by far the most common with carbankerite (coal + carbonate minerals) of secondary occurrence (table 3). Carbopyrite (coal + sulfide minerals) and carbsilicite (coal + quartz) are relatively minor. Carbargilite percentages are greater in the higher-quality Beluga Formation coals for two reasons: 1) these coals are more fissile and contain an inordinate amount of partings; and 2) volcanic ash beds, volcaniclastic laminae, and disseminated volcaniclastic material are more abundant. Carbankerite percentages are higher in Sterling Formation coals than Beluga Formation coals. In addition, the types of carbankerite vary in each unit. The Sterling Formation has more calcite and altered carbonate grains, whereas the Beluga Formation contains a higher percentage of siderite/dolomite intergrowths. Carbosilicites or detrital quartz grains are of minor occurrence in both Beluga and Sterling Formation coals. Carbopyrites are also minor but show a slight increase in the Cook Inlet Sterling Formation coals. A one-ft coal bed in the Beluga Formation at Whiskey Gulch on Cook Inlet contains 2.94 percent total sulfur, a large proportion of which occurs in the framboidal form as seen petrographically.

The carbomineralite content of southern Kenai lowland coals clearly increases upsection and is prevalent on both coasts of the peninsula, but especially on the west coast. The elevated carbomineralite content may be indicative of increased volcanism in the Alaska Range during deposition of the Sterling Formation.

Vitrinite Reflectance Analysis

Vitrinite reflectance values ($\bar{R}om$) increase downsection with increased rank and hence are relatively greater in the older, higher-quality coals of the Beluga Formation. Figure 24 shows the variation in vitrinite reflectance for the three major coal zones of southern Kenai Peninsula. Beluga Formation

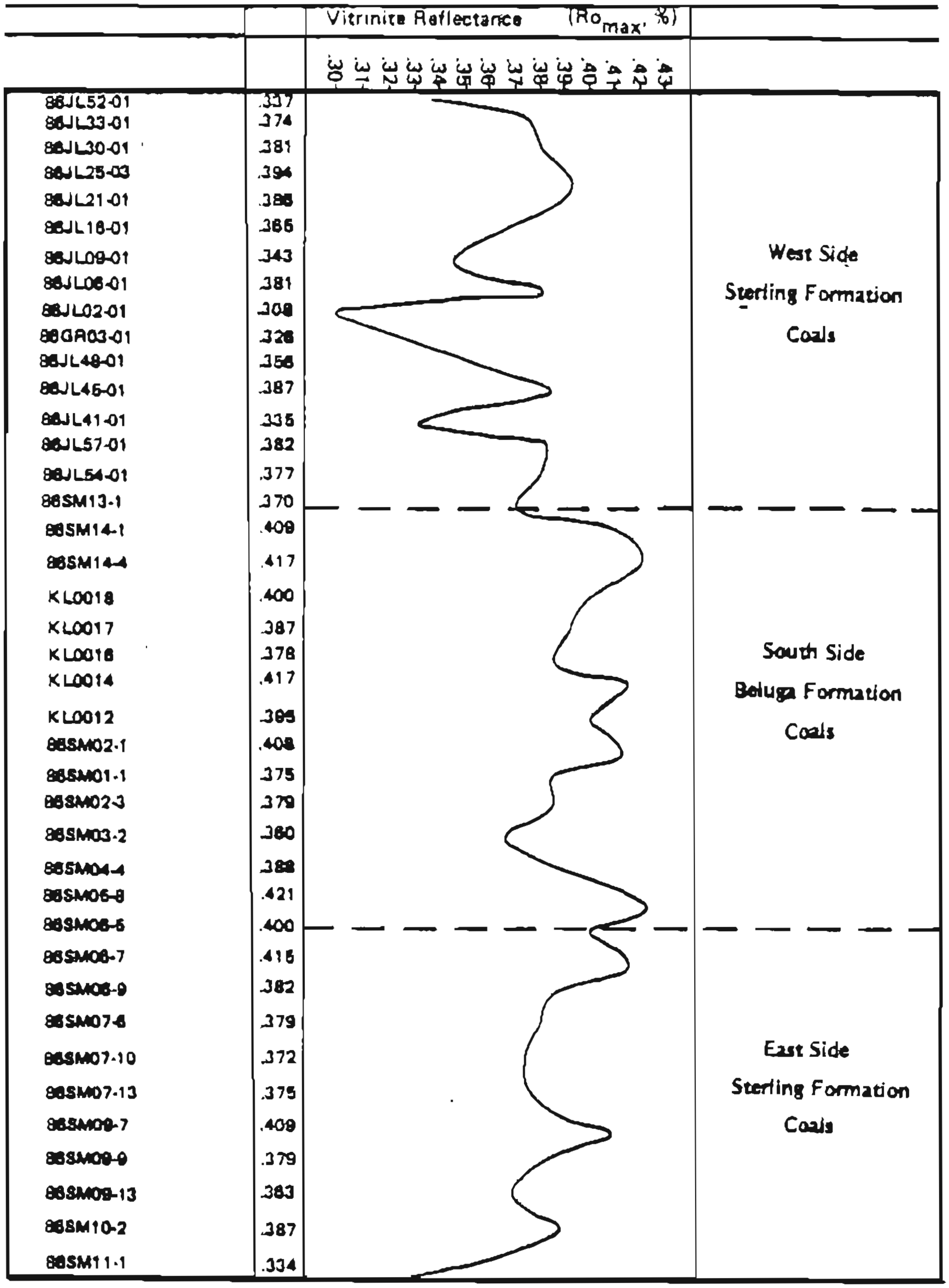

Figure 24. Variation plot of vitrinite reflectance (% $\bar{R}o_{max}$) for the three major provisional coal zones of the southern Kenai Peninsula.

coals exhibit an average vitrinite reflectance of 0.37 percent whereas the Sterling Formation coals average 0.32 percent (table 5). Correlation between rank and vitrinite reflectance is typically poor in low-rank coals such as those of the Sterling and Beluga Formations of the southern Kenai lowland.

Summary of Previous Coal-quality Investigations

Coals of the Homer district, southern Kenai lowland, are less mature than Tyonek Formation coals of the Beluga field; they contain higher ash and volatiles and less fixed carbon (Sanders, 1981). Barnes and Cobb (1959) noted the lenticular nature of the coal beds and their general northward decrease in thickness, quality, and rank. The coals are dull, platy, and cleated in appearance with considerable evidence of woody and bark tissues (Sanders, 1981); these woody, lignitic coals have colloquially been referred to as 'plianite.'

Barnes (1962) found that in comparing various Tertiary-age coals of the Cook Inlet basin that coals in outcrops of the Kenai field were the lowest in rank. In core samples from the Kenai field, he found that the coals show a general increase in rank with depth (ranging from subbituminous to high-volatile bituminous). He concluded that load metamorphism was chiefly responsible for increasing the rank of the deeper Kenai field coals.

Coals from outcrops of the Homer district range in rank from lignite to subbituminous B, but typically are subbituminous C (Barnes, 1967). The average heating value is 7,700 Btu/lb as-received and 8,900 Btu/lb air dried (Barnes and Cobb, 1959). They are high in moisture, low in sulfur (0.2-0.4 percent), and ash content ranges from 3.2 to 22.6 percent (as-received basis). Rao and Wolff (1981) presented detailed analyses of the 6-ft thick Cabin bed (locality 117 of Barnes and Cobb, 1959). The analysis revealed 23 percent moisture, 8.65 percent ash, 0.23 percent total sulfur, and 8028 Btu/lb (all equilibrium bed moisture basis). Abernethy and Cochrane (1960) listed values for ash fusibility of representative mine samples (table 6).

Rao and Wolff (1982) found that coal beds from Ninilchik and Happy Creek in the Kenai field could be washed to give low sulfur products with acceptable ash. The 1.40 specific gravity float product from Ninilchik analyzed 8.16 percent ash whereas the product from Happy Creek analyzed 9.03 percent ash. Total sulfur averaged less than 0.40 percent for each coal.

Comparison of 10 Kenai Quadrangle coals with 33 coal samples from the Powder River region (Affolter and others, 1981) show that the Kenai Quadrangle coals are significantly higher in volatile matter and ash, but significantly lower in fixed carbon, carbon, total sulfur and pyritic sulfur, and heats of combustion. Moisture, hydrogen, nitrogen, oxygen, and organic sulfur contents are not significantly different.

Comparison of six Seldovia Quadrangle coals with 33 coal samples from the Powder River region (Affolter and others, 1981) show that the Seldovia Quadrangle coals are significantly higher in volatile matter and ash, and are significantly lower in moisture, fixed carbon, total sulfur, sulfate and pyritic sulfur contents. The hydrogen, carbon, nitrogen, and oxygen contents, and the heats of combustion are not significantly different.

Table 5. Average vitrinite reflectance values for coals of the southern Kenai Peninsula.

Coals	No. of samples	Average reflectance (%)
Cook Inlet Sterling Formation	38	0.323
Kachemak Bay Beluga Formation	30	0.366
Kachemak Bay Sterling Formation	32	0.328

Table 6. Fusibility of ash for Homer district, Kenai coal field mine samples. From Abernethy and Cochrane, 1960.

Location	Bed	No. of samples	Fusibility of ash F° Initial deform. temperature	Fusibility of ash F° Softening temperature	Fusibility of ash F° Fluid temperature	%, dry basis Ash	%, dry basis Sulfur
Bluff Point	Cooper	3	1950	1970	2030	11.8	0.4
Homer Coal Corp.	Cooper	1	2780	2840	2910+	14.5	0.5
Homer Coal Corp.	---	2	2040	2090	2280	21.5	0.4
Homer outcrop	---	1	2380	2410	2440	4.5	0.2

Comparison of 10 Kenai Quadrangle coals with 410 Powder River region coal samples (Affolter and others, 1981) shows that the Kenai Quadrangle coals are significantly higher in ash, and that the ash is significantly higher in SiO_2, MgO, Na_2O, and K_2O contents, and significantly lower in CaO and SO_3 contents. Contents of Al_2O_3, Fe_2O_3 and TiO_2 are not significantly different.

Comparison of 34 Seldovia Quadrangle coals with 410 Powder River region coal samples (Affolter and others, 1981) shows that the Seldovia Quadrangle coals are significantly higher in ash, and that the 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.

Comparison of geometric mean contents of 35 elements in 10 Kenai Quadrangle coal samples with 410 Powder River region coal samples (Affolter and others, 1981) shows that the Kenai Quadrangle coals are significantly higher in Si, Al, Mg, Na, K, Ti, Ba, Co, Cr, Cu, Ga, Mn, Mo, Nb, Ni, Sc, V, Y, and Yb, and significantly lower in Ca, B, and Se. The contents of Fe, As, Be, F, Hg, Li, Sb, Sr, U, Zn, and Zr are not significantly different.

Comparison of geometric mean contents of 35 elements in 34 Seldovia Quadrangle coal samples with 410 Powder River region coal samples (Affolter and others, 1981) show that the Seldovia Quadrangle coals are significantly higher in Si, Al, Ca, Na, K, Fe, Ti, As, Ba, Co, Cr, Cu, F, Ga, Mn, Ni, Sb, Sc, Sr, V, Y, and Yb, and significantly lower in Mg, B, Be, Pb, Se, Th, and Zr. The contents of Hg, Li, Mo, Nb, U, and Zr are not significantly different.

Current Coal-quality Investigations

Methods of Proximate Analysis

Proximate analysis, including moisture, ash, volatile matter and fixed carbon (by difference), was completed on 145 coal samples from the southern Kenai lowland (table B1, appendix B). ASTM standards for laboratory analysis of coal apply only to fresh, unweathered samples. However, ASTM procedures were followed in analyzing Kenai outcrop coal samples so that results are as close as possible to values obtained by analysis of fresh samples from the same beds.

All the coal samples were initially dried at 30°C for 24 hr to measure the air dried loss (ADL) or percent overall weight loss. Subsequently, as-determined moisture (Mad) values were measured after further drying of the ADL samples in an oven at about 105°C for 60 minutes. As-received moisture (Mar) values were mathematically derived from the ADL and Mad values, and represent an approximation of in-place moisture contents of the coals. Equilibrium bed moisture (EBM) was performed on all the coals for which sufficient sample was available. EBM values were determined on separate sample splits that were not air dried and were meant to approximate the moisture content the coal would have if it had not been weathered.

For relatively highly-weathered outcrop samples of low-rank coals as those of the Kenai lowland, the as-received moisture is probably a closer approximation of the 'real' moisture than the equilibrium bed moisture (P.D. Rao, personal commun., 1987). Because of the breakdown of the functional groups in the coals, all of the original moisture could not be readmitted to the coal structure in the equilibrium bed moisture procedure. Generally, as-received moisture was greater than equilibrium moisture in the coals. In cases where it was much greater, the coals were sampled in a waterfall or creek bed which increased their surface moisture.

Heating values (Btu/lb) were determined with an adiabatic calorimeter. Total sulfur was determined using a Fisher sulfur analyzer in which the coals were burned and the resulting gases automatically titrated to obtain the sulfur content. Duplicate samples were analyzed in each case.

Proximate Analysis Results

Figures 25 through 27 compare average proximate analysis, total sulfur and heating value results on different bases for coals of the southern Kenai Peninsula. Among the conclusions that can be drawn from the analytical data are: 1) older, higher-ranked Beluga Formation coals are generally lower in moisture content; 2) ash content is variable depending on random, local conditions of deposition; 3) volatile matter increases in the younger, lower-ranked Sterling Formation coals; 4) fixed carbon increases with depth, age, and increasing rank, and hence, is highest in Beluga Formation coals; 5) heating values increase downsection with increased rank; and 6) all the Kenai lowland coals exhibit very low sulfur contents.

Major-Oxide and Trace Element Geochemistry

Methods for Elemental Analyses of Coal Ash

The inorganic fraction of coal, on the average, is about 15 percent by weight. The elemental analysis of coals refers to the characterization of this fraction. Characterization is necessary if the coal is to be used effectively in industrial processes because the inorganics are not easily separated out, and often play an important role by causing abrasion, fouling and pollution. Figure 28 indicates the general analytical scheme for inorganic constituents in coal. The first step in elemental analyses is to remove the organic fraction. This is necessary because current analytical techniques are not capable of routinely determining many inorganic elements in a predominantly organic matrix. The organic fraction is usually removed by ashing techniques which combust the organics leaving behind inorganic residues or 'ashes.'

High-temperature ashing is usually done in a muffle furnace open to the atmosphere. About 10 grams of the as-received sample (-60 mesh) are weighed into a ceramic crucible, slowly heated to a temperature of 750°C and held there overnight. The slow heating minimizes any interactions which may occur between phases breaking down at different temperatures. The resulting high-temperature ash (HTA), which is composed mainly of elemental oxides, silicates and some sulfates, is ground to -200 mesh, reheated to 750°C for 3 hr to drive

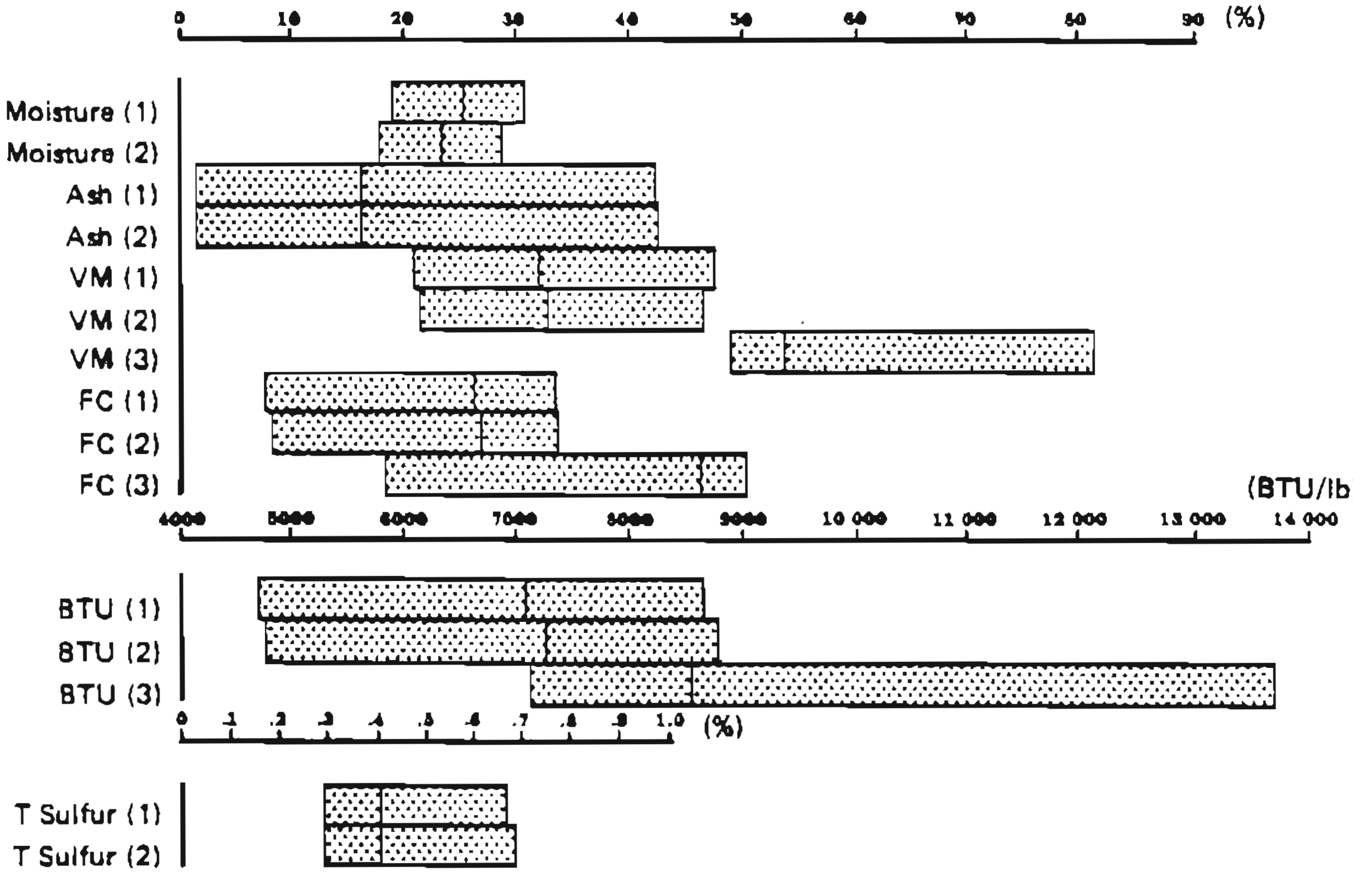

Figure 25. Comparison of range and mean values for various coal-quality parameters in 64 zone-1 coals of Cook Inlet (west side) Sterling Formation.

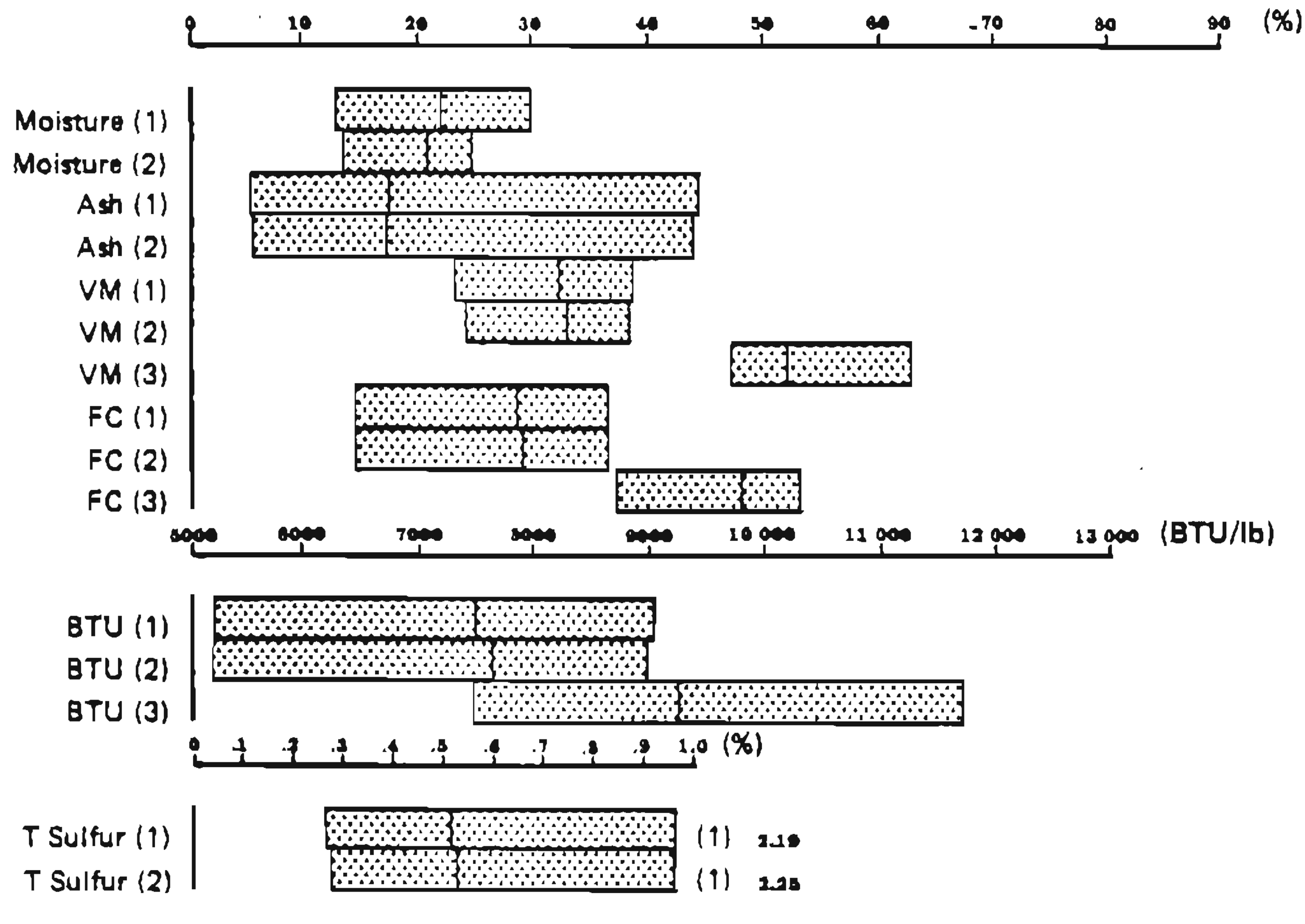

Figure 26. Comparison of range and mean values for various coal-quality parameters in 44 zone-2 coals of Kachemak Bay (south side) Beluga Formation.

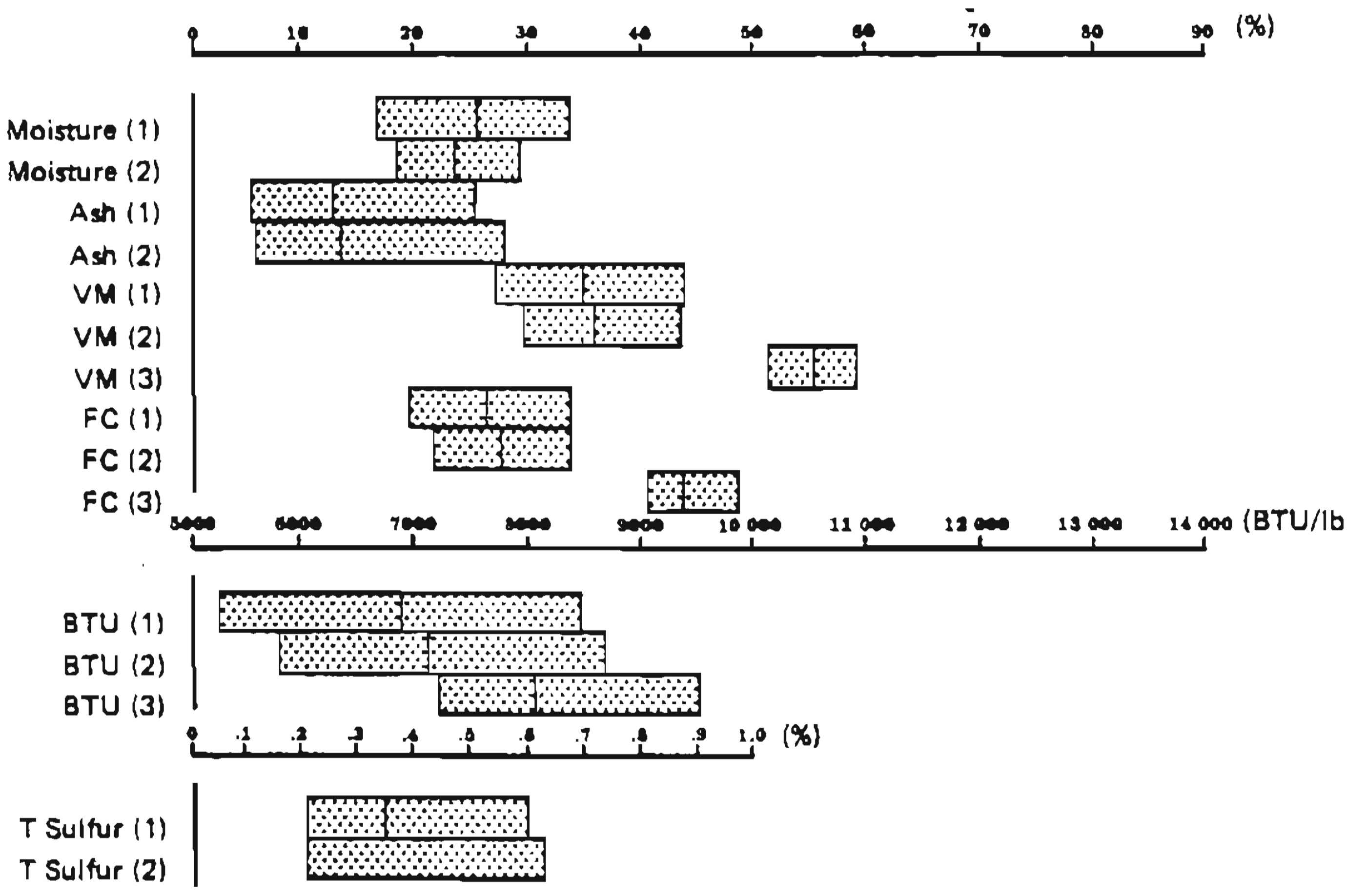

Figure 27. Comparison of range and mean values for various coal-quality parameters in 35 zone-3 coals of Kachemak Bay (east side) Sterling Formation.

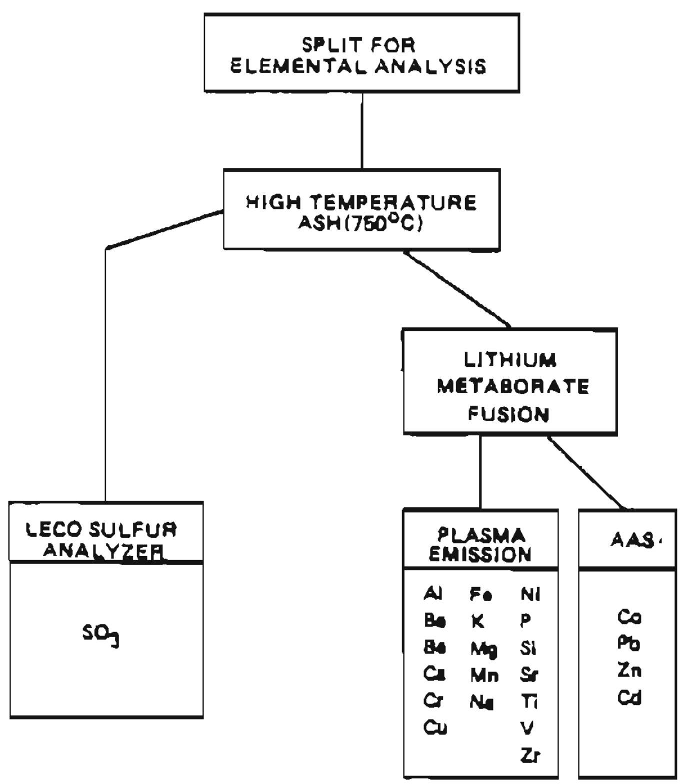

Figure 28. Analytical scheme for inorganic constituents in coal.

off any moisture which it may have acquired during the grinding process, and analyzed.

The high-temperature ash (HTA) is analyzed by a combination of plasma emission and atomic absorption spectrometry. Both of these methods require solutions for elemental analysis. The HTA is dissolved using a modified version of the lithium metaborate fusion technique of Medlin and others (1969) as follows:

(1) Reagents required: Lithium metaborate, anhydrous-$LiBO_2$; nitric acid, HNO_3, reagent grade; lithium carbonate, Li_2CO_3, high purity.

(2) Dissolving solution: 4 percent nitric acid solution with 0.1 percent H_2O_2 (v/v).

(3) Sample solution preparation: Mix 0.2000 gram of -200 mesh HTA with 1.000 gram of lithium metaborate, transfer to a high-purity graphite fusion crucible and place in muffle furnace at 1,000°C for 10 min. Transfer 100 mls of the dissolving solution to a teflon beaker and add a stirring bar. Remove the crucible from the furnace, swirl and pour the melt into the beaker. Cover and stir without heating until the melt has dissolved (5 to 10 min). Concentration of the sample in this solution is 2,000 ppm.

(4) Solution for the determination of Be, Co, Cr, Cu, Ni, P, Pb, V, Zn, Zr, and Cd: The prepared solution is to be used directly, without dilution, for the determination of these elements.

(5) Dilute solution for the determination of Al, Ba, Ca, Fe, K, Mg, Mn, Na, Si, Ti, and Sr: Dilute 4.0 mls of the prepared solution with 60 mls of the diluting solution. Concentration of the solution is 125 ppm.

Upon the completion of the HTA dissolution, the solutions are run for major, minor and trace elements using a Spectometric Spectraspan IV plasma emission spectrometer. The analyte is nebulized and carried by argon gas into an ICP or a DCP argon plasma which excites the sample causing radiation to be emitted. The radiation is dispersed into a spectrum by a prism and an echelle grating. Specific wavelength portions of the spectrum are monitored by a series of twenty photomultiplier tubes, each corresponding to a particular element. Each sample is monitored for 12 to 15 sec, while ten elements are determined simultaneously. The instrument is calibrated using certified NBS and Canmet reference materials for major elements---Si, Al, Fe, Mg, Ca, Na, K, Ti, and Mn. These are analyzed simultaneously using the DC plasma. The trace elements---Ba, Sr, Cr, Ni, Co, P, V, Cu, and Zr---are analyzed using the Spex standards in an $LiBO_2$ matrix for calibration. Although all ten trace elements could be theoretically analyzed simultaneously they are determined in three sets.

The samples are run in groups of 10 followed by a high standard so any necessary adjustments can be made allowing for drift. This is done using a prepared program that makes these adjustments with respect to the position of each sample during the run, and the instrument is restandardized at the end of each run.

Although most of the elements listed under 'plasma emission' in figure 28 could be determined equally well with atomic absorption spectrometry, the plasma spectrometer provides a greater advantage in the time it saves because it is capable of rapidly and precisely determining five to ten elements simultaneously. The higher temperatures (5,000-6,000°C) attainable in the plasma spectrometer also gives much lower detection limits for the refractory elements such as titanium and zirconium. Currently, Co, Cd, Pb and Zn are done by atomic absorption.

Results of Elemental Analyses of Coal Ash

Tables B2 and B3 of appendix B list detailed results of elemental analyses of southern Kenai Peninsula coals. Coal ashes of the Beluga Formation are richer in CaO and Na_2O, whereas ashes of Sterling Formation coals are richer in SiO_2 (table 7). Coals of the Sterling Formation from Cook Inlet and Kachemak Bay sides of the peninsula show very similar compositions of major oxides. The ranges in the composition of major oxides in southern Kenai Peninsula coals are very similar to those in other coals (table 8). Some Kenai Peninsula coals may show higher contents of silica, magnesia, and calcium oxide than other coals.

Older Beluga Formation coals are significantly higher in barium and strontium than Sterling Formation coals (table 9). Coals of the Sterling Formation on the Kachemak Bay side of the peninsula are typically higher in most trace elements compared to coal ashes of the Sterling Formation on the Cook Inlet side of the peninsula.

Coals of the southern Kenai Peninsula show significantly higher contents of barium, cadmium, chromium, cobalt, copper, lead, nickel, strontium, vanadium, and zirconium than other U.S. coals (table 10). They show similar or relatively lower contents of beryllium and zinc.

Coal Resources and Development Potential

Barnes and Cobb (1959) cited at least 30 coal beds over 2-ft thick and many thinner beds in the Homer district. Conwell (1977) stated that there were over 37 coal beds in Sterling Formation strata along the southwest coast of the Kenai Peninsula. Although the maximum coal-bed thickness is about 20-ft, the typical range is from 3-7 ft thick (Barnes and Cobb, 1959).

Most coal beds in the Homer district are lenticular; individual beds generally change markedly in thickness within short distances (Barnes and Cobb, 1959). They may be interbedded with other sediments throughout the lowland in roughly the same proportions observed in the cliffs, but the likelihood of lateral facies changes makes extrapolation highly uncertain beyond distances of 0.5 mi.

Little is known about the actual areal extent of most coal beds. The number and thickness of coal beds decreases northward on the Kenai Peninsula (Barnes and Cobb, 1959). Coal beds are present throughout the Kenai Group rocks on the southern Kenai Peninsula. The thickest and most abundant coal beds are in the Beluga Formation strata at the south end of the Homer dis-

Table 7. Comparison of major-oxide composition of coals from the three major zones of the southern Kenai Peninsula. The average composition of all Kenai field coals analyzed is also listed.

Major oxide	Sterling Formation, Cook Inlet (14)	Sterling Formation, Kachemak Bay (10)	Beluga Formation, Kachemak Bay (7)	All Kenai field coals
SiO_2	48.90	45.84	39.59	45.80
Al_2O_3	18.37	18.20	18.12	18.26
Fe_2O_3	6.39	6.76	6.96	6.64
MgO	4.36	4.62	3.81	4.32
CaO	10.48	11.15	15.49	11.83
Na_2O	1.69	1.07	2.13	1.59
K_2O	1.40	1.54	1.52	1.47
TiO_2	0.81	0.78	0.72	0.78
MnO	0.14	0.18	0.10	0.15
P_2O_5	0.44	1.31	1.42	0.94

Table 8. Typical limits of major-oxide ash composition of southern Kenai Peninsula coals compared to other coals. Ranges in other coals from McClung and Geer, 1979.

Constituent	Southern Kenai Peninsula	United States	England	West Germany
Acidic oxides:				
Silica (SiO_2)	26-60	20-60	25-50	25-45
Alumina (Al_2O_3)	11-23	10-35	20-40	15-21
Titania (TiO_2)	0.6-1.0	0.5-2.5	0-3	---
Basic oxides:				
Ferric oxide (Fe_2O_3)	4-12	5-35	0-30	20-45
Calcium oxide (CaO)	3-23	1-20	1-10	2-4
Magnesia (MgO)	2.4-8	0.3-4	0.5-5	0.5-1
Alkalies ($Na_2O + K_2O$)	1-6	1-4	1-6	---
Other oxides:				
Sulfur trioxide (SO_3)	---	0.1-12	1-12	4-10
Phosphorous pentoxide (P_2O_5)	0.0-3.0	0.7-5.5	0-3	---

Table 9. Comparison of the trace-element contents of coals from the three major zones of the southern Kenai Peninsula. The average contents of trace elements in all Kenai field coals analyzed are also listed.

Trace element	Sterling Formation, Cook Inlet (14)	Sterling Formation, Kachemak Bay (10)	Beluga Formation Kachemak Bay (7)	All Kenai field coals
Cr	213	599	561	416
Ni	115	191	232	166
Co	133	49	78	94
V	346	426	404	385
Cu	206	198	212	204
Zr	177	242	257	216
Ba	2173	3429	4919	3198
Sr	820	1480	2766	1472
Be	2.0	2.2	3.0	2.3
Zn	54	63	59	58
Pb	<58	<66	<61	<61
Cd	<10	<10	<10	<10

Table 10. Comparison of arithmetic mean, minimum, and maximum values for certain trace-element contents in southern Kenai Peninsula coals with Illinois basin, eastern United States, and western United States coals. Values in other coals from Gluskoter and others, 1977. Contents reported in ppm. 1 = arithmetic mean; 2 = minimum value; 3 = maximum value; and 4 = number of samples.

Element	Illinois Basin				Appalachian coal fields				Western United States				Southern Kenai Peninsula			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Barium (Ba)	100	5	750	(56)	200	72	420	(14)	500	160	1600	(22)	3198	1030	7785	(31)
Beryllium (Be)	1.7	0.5	4.0	(113)	1.3	0.23	2.6	(23)	0.46	0.10	1.4	(29)	2.3	1.0	4.1	(31)
Cadmium (Cd)	2.2	0.1	65	(93)	0.24	0.10	0.60	(23)	0.18	0.10	0.60	(29)	<10	<10	<10	(31)
Chromium (Cr)	18	4.0	60	(113)	20	10	90	(23)	9.0	2.4	20	(29)	416	118	1214	(31)
Cobalt (Co)	7.3	2.0	34	(113)	9.8	1.5	33	(23)	1.8	0.60	7.0	(29)	94	27	254	(31)
Copper (Cu)	14	5.0	44	(113)	18	5.1	30	(23)	10	3.1	23	(29)	204	78	333	(31)
Lead (Pb)	32	0.8	220	(113)	5.9	1.0	18	(23)	3.4	0.70	9.0	(29)	<61	<50	83	(31)
Nickel (Ni)	21	7.6	68	(113)	15	6.3	28	(23)	5.0	1.5	18	(29)	166	67	493	(31)
Strontium (Sr)	35	10	130	(56)	130	28	550	(14)	260	93	500	(22)	1472	190	6045	(31)
Vanadium (V)	32	11	90	(113)	38	14	73	(23)	14	4.8	43	(29)	385	230	707	(31)
Zinc (Zn)	250	10	5300	(113)	25	2.0	120	(23)	7.0	0.30	17	(29)	58	23	118	(31)
Zirconium (Zr)	47	12	130	(88)	45	8.0	88	(19)	33	12	170	(26)	216	91	501	(31)

trict; it contains numerous persistent coal beds to 1-m thick. The Sterling Formation contains less numerous and thinner beds than in the Beluga Formation; it does contain one 2-m thick bed (Hayes and others, 1976). Coal beds are very limited on the south shore of Kachemak Bay; thin streaks of coal occur in Kenai Group strata along the coast between Barbara Point and Seldovia Point. At Port Graham, coal is exposed in Tyonek Formation strata for about 0.25 mi along the coast.

McFarland (1978) estimated a 65-million-ton recoverable reserve of subbituminous coal in the Homer field. He added that communication with a private leaseholder suggested the possibility of several hundred million tons at an approximate 5:1 stripping ratio. Conwell (1977) stated that in some areas such as Deep Creek the overburden is shallow and the stripping ratio should be less than 10:1.

Barnes and Cobb (1959) estimated identified coal resources in the Homer district within 0.5 mi of the shores of Cook Inlet and Kachemak Bay to be about 50 million tons in beds 5-ft or more in thickness, and 500 million tons in beds 2-ft or more in thickness. Barnes (1967) cited an indicated or demonstrated resource of 318 million tons on the Kenai Peninsula in 2.5-10.0 ft beds. McGee and O'Connor (1974) cited a similar estimate of 320 million short tons of identified resources (onshore only). An isopach map prepared by McGee and O'Connor shows that total coal thickness from surface to 2,000 ft depth ranges up to 75 ft on the southern Kenai Peninsula (fig. 29).

Barnes and Cobb (1959) made no estimate as to total hypothetical coal resources. McGee and O'Connor (1974), however, estimated total hypothetical coal resources (onshore only) at 35 billion short tons. They estimated offshore hypothetical resources to 2,000-ft depth beneath Cook Inlet at 150 billion tons. They estimated offshore hypothetical and speculative resources of lignite and subbituminous coal to 10,000-ft depth under Cook Inlet at 1.3 trillion tons. Over 50 billion tons of this was in beds over 20-ft thick. In 1973, the Alaska Department of Natural Resources received requests for coal-prospecting permits under Cook Inlet near producing oil wells. The requests may have been related to in situ or solution mining (Conwell, 1977).

Consolidation Coal Company completed a subsurface coal exploration project in the Cape Ninilchik area, Kenai Peninsula in 1976. At that time they held several State coal lease tracts in that area. Only 12 of the original 22 proposed holes were completed because of drilling problems. They concluded that the significant thicknesses of unconsolidated overburden sediments that hampered drilling and coring operations would present challenging problems for mining.

Conwell (1977) stated that the inherent advantages of Sterling Formation coals are relatively flat beds in a low-relief terrain suitable for strip mining and their proximity to tidewater for export. The complicated land status on the Kenai Peninsula will preclude mining in many areas and slow development or reduce the size of potential lease tracts in other areas (fig. 30). In addition to some private land holdings, State and Federal governments and native corporations hold titles to various areas. The Kenai National Wildlife Refuge is federal land mostly outside of the Homer district.

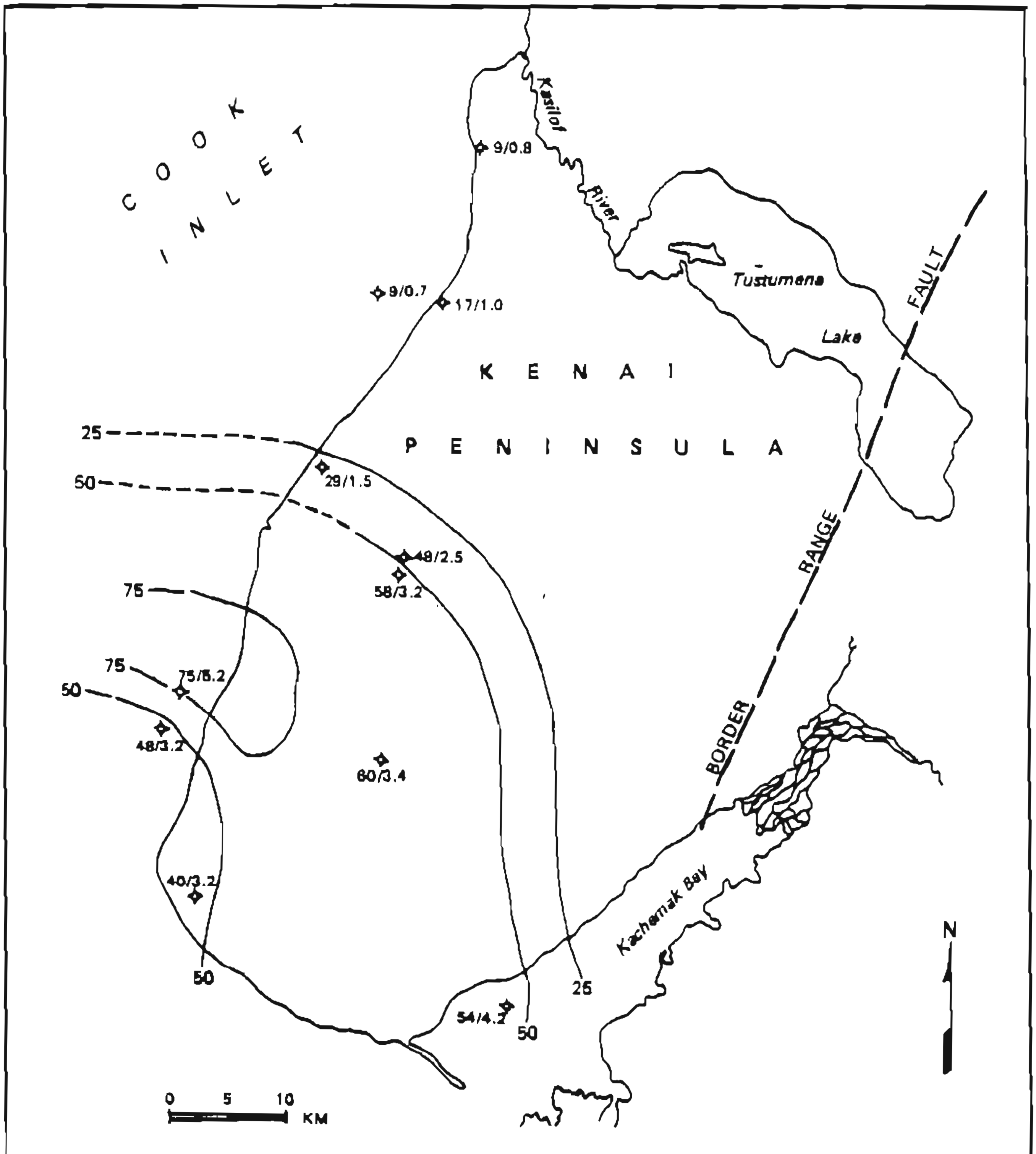

Figure 29. Cumulative coal thickness map of southern Kenai Peninsula, surface to 2,000 ft depth. From McGee and O'Connor, 1975. For control points shown, numerator indicates cumulative coal thickness and the denominator indicates percentage of coal in measured section. Contour interval is 25 ft.

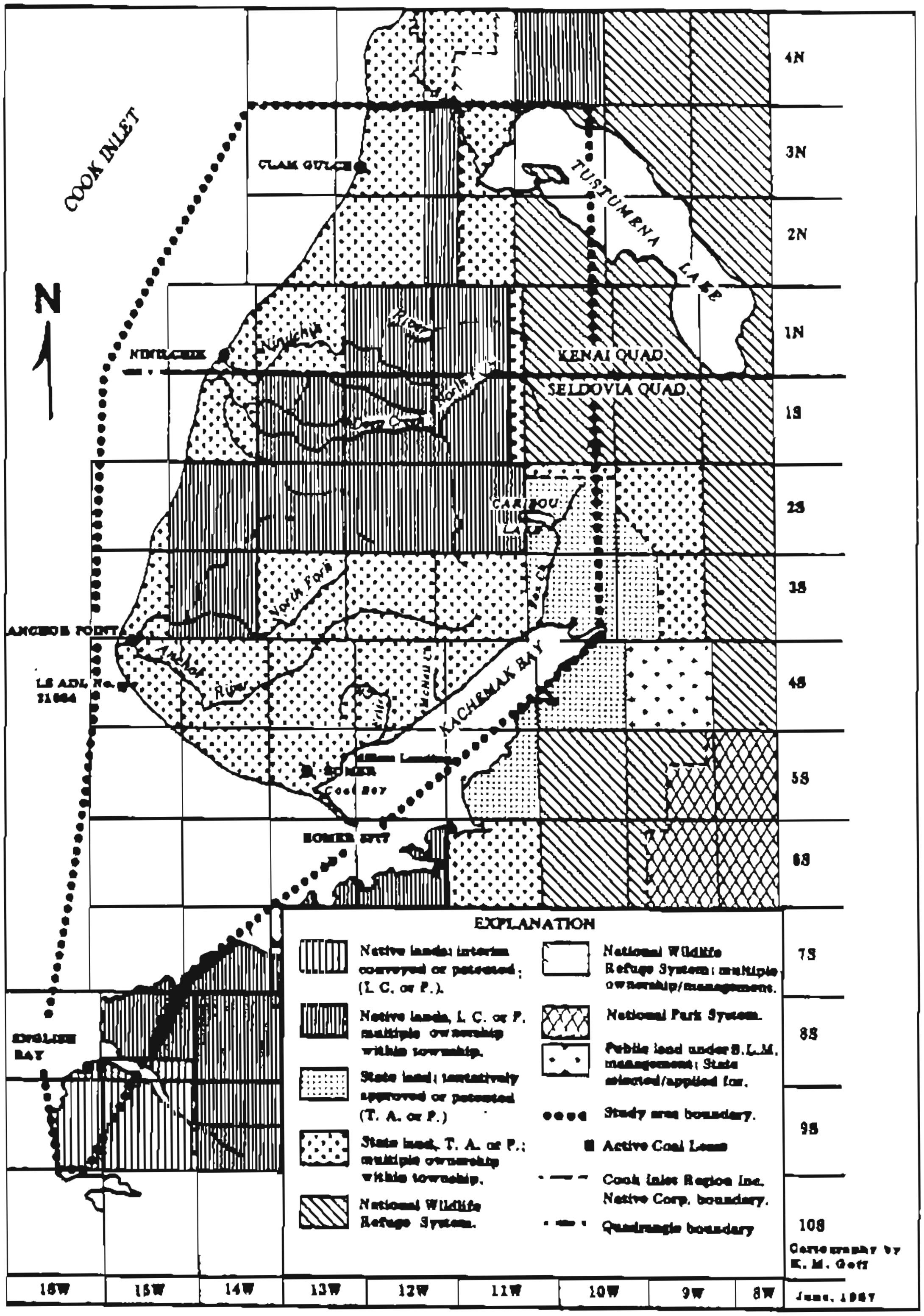

Figure 30. Generalized land-status map of southern Kenai Peninsula coal project area. Modified from U.S. Bureau of Land Management, 1986.

The State of Alaska has title to most of the Kenai coal field, and some state land selections are still pending. Intensive recreational, private and municipal surface use may prevent surface mining in the Homer district, Kenai coal field. There may be potential for underground recovery, however (Sanders, 1981).

Based on recent investigations of the coal resources of the southern Kenai Peninsula, 11 coal-resource blocks have been delineated (fig. 31). New estimates of measured, identified, and hypothetical resources have been computed for each of these blocks (arranged from largest to smallest). As shown, the Homer district of the Kenai field contains total calculated measured, identified, and hypothetical coal resources of 57.6, 347.2, and 41,550 million short tons, respectively (table 11).

Originally, one or two boreholes were scheduled to be drilled in the Homer district as a part of this project. However, final funding was not sufficient to allow this. But several proposed drill holes (PDH1-PDH10) have been located for future consideration should additional funding become available (table 12). Two types of holes have been proposed---those for collecting mainly geologic information and those for collecting mainly resource information. PDH1 and PDH2 were the two holes that were originally located and evaluated for drilling during the course of this project, and hence should be given a somewhat higher priority for future drilling than the other proposed holes.

Overburden Character and Reclamation Potential

Thirty overburden samples from the Homer district of the Kenai coal field were analyzed for their geochemical and physical characteristics. Locations for samples are identified in appendix A. Resulting data are summarized in table 13 and listed in detail in table C2 of appendix C.

The average texture of the rock samples is 20 percent sand, 30 percent clay, and 50 percent silt; as a mine soil, the material would be classified generally as a clay loam. The samples analyzed were relatively high in carbonaceous matter, revealing an average total organic matter content of 7.75 percent.

Based on the analysis results, the overburden samples show no tendencies for the development of acidic or saline conditions in mine soils formed from them. Total sulfur values are very low and paste pHs are near normal. Although acid base potentials for individual samples show a slight deficiency in available neutralizing agents of less than 1 ton $CaCO_3$ equivalent/1,000 tons of material, overall ameliorating capacity is thought to be adequate. Should minor acidic conditions develop locally in mine soils, the amounts of neutralizing agents that would have to be added are feasible and practical from an agronomic standpoint. Exchangeable sodium percentages and sodium adsorption ratios support the contention that salt accumulation and high sodium substratum materials are unlikely to develop.

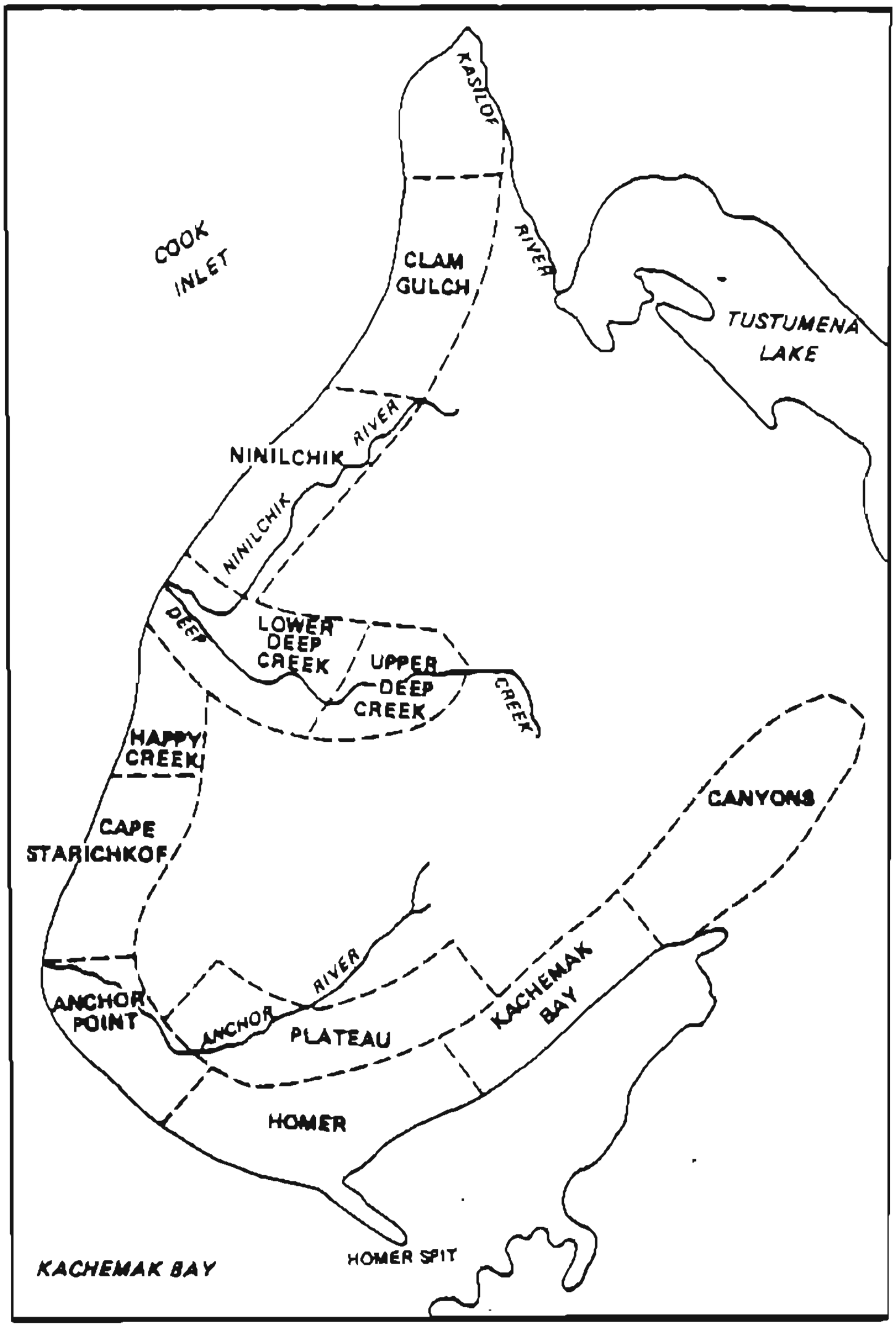

Figure 31. Coal-resource blocks of the Homer district, southern Kenai Peninsula.

Table 11. Calculated measured, identified, and hypothetical coal resources (as based on USGS criteria, Wood and others, 1983) in millions of short tons for defined resource blocks in the Homer district of the Kenai coal field.

Resource block	Measured	Identified	Hypothetical
Homer	11.4	68.2	8,250
Canyons	11.2	67.5	8,000
Kachemak Bay	10.0	60.0	7,250
Lower Deep Creek	6.5	39.0	4,750
Ninilchik	4.9	30.0	3,500
Plateau	4.2	25.5	3,000
Happy Creek	3.4	20.2	2,500
Anchor Point	2.8	16.5	2,000
Clam Gulch	2.1	12.8	1,500
Upper Deep Creek	0.7	4.5	500
Cape Starichkof	0.4	3.0	300
TOTAL	57.6	347.2	41,550

Table 12. Proposed drill holes for gathering geologic and resource information in the Homer district, Kenai coal field based on recent investigations. Little consideration was given to land status during hole location.

Proposed drill hole	Area	Type	Latitude (N)	Longitude (W)	Justification
PDH1	Fritz Creek	Geologic information	59°43'37"	151°21'10"	Tie in and correlate Sterling Formation and Beluga Formation coals; check the extent of coals.
PDH2	Deep Creek	Resource information	60°00'40"	151°38'10"	A 15-ft thick coal bed reported by Consolidation Coal Co.
PDH3	Swift Creek	Resource information	59°49'09"	151°06'21"	Thick N through U beds close to surface.
PDH4	Homer Escarpment	Geologic information	59°40'27"	151°33'40"	Tie in and correlate Sterling Formation and Beluga Formation coals; determine the extent of Cabin and Cooper beds.
PDH5	McNeil Canyon	Resource information	59°43'30"	151°15'24"	Thick B, C, D, E, and F beds close to surface.
PDH6	Bluff Point	Resource information	59°39'54"	151°40'38"	Many thick Beluga Formation coals, including from Cooper bed down.
PDH7	Ninilchik	Resource information	60°03'29"	151°38'45"	Seven coals greater than 3-ft each and four coals greater than 5-ft each.
PDH8	Whiskey Gulch	Geologic information	59°50'52"	151°48'21"	Determine the Sterling Formation/Beluga Formation contact in long covered interval.

Table 12. (con.)

Proposed drill hole	Area	Type	Latitude (N)	Longitude (W)	Justification
PDH9	Anchor Point	Geologic information	59°46'47"	151°50'20"	Determine the basal Beluga Formation beds and fill in information for long covered interval.
PDH10	Homer	Geologic information	59°40'52"	151°23'34"	Discover and tie in missing geology between Fritz Creek and the Homer Coal Corporation Mine.

Table 13. Summary geochemical and physical characteristics of analyzed coal-overburden samples from the southern Kenai Peninsula.

Overburden parameter	Range	Mean	Units
paste pH	5.62-7.99	7.03	pH
Electrical conductivity	0.27-6.50	1.41	mmhos/cm
Saturation percentage	47.92-98.68	67.50	%
Water soluble cations			meq/liter
Calcium (Ca)	0.80-11.98	2.33	
Magnesium (Mg)	0.66-22.25	2.93	
Sodium (Na)	0.64-57.42	9.71	
Sodium adsorption ratio	0.43-25.77	6.63	ratio
Exchangeable sodium percentage	-10.09-12.93	1.66	%
Particle size			%
Sand	1-50	20	
Silt	21-73	50	
Clay	10-77	30	
Texture class	SiL, SiC, SiCL, C, CL, CLC	CL	---
Organic matter	0.87-46.5	7.75	%
Extractable nutrients			ppm
Nitrate nitrogen (NO_3)	<0.8-99.2	<6.8	
Phosphorous (PO_4)	<2.0-5.6	<2.4	
Potassium (K)	66.1-638.0	275.8	
Cation exchange capacity	2.46-74.31	23.60	meq/100 gms
Total sulfur	0.011-0.194	0.053	%
Pyritic sulfur	0.002-0.032	0.009	%
Organic sulfur	0.00-0.17	0.02	%
Sulfate sulfur	<0.02-<0.02	<0.02	%
Calcium carbonate	-4.8-2.4	0.02	%
Acid base potential (based on total sulfur)	-48.38-21.88	-0.81	tons $CaCO_3$ equivalent/ 1,000 tons
Acid base potential (based on pyritic sulfur)	-48.42-23.48	-0.06	tons $CaCO_3$ equivalent/ 1,000 tons
Trace elements			ppm
Boron	0.22-8.65	1.9	
Copper	11.2-56.2	25.3	
Molybdenum	<0.5-1.8	<0.7	
Lead	<2.5-7.5	<3.5	
Selenium	0.01-0.29	0.11	

Trace element contents show that it is unlikely that problems with metal phytotoxicity will develop as a result of the accumulation of metals in plant tissue that might be toxic to wildlife. A positive growth response may result from the addition of one or more of the extractable macronutrients (NO_3, PO_4, or K) during mine-spoil revegetation.

CONCLUSIONS

Compilation of new maps (scales of 1:63,360 and 1:125,000) of the Homer district of the Kenai coal field has aided in the resolution of remaining questions relating to the stratigraphy and structure of the Tertiary Beluga and Sterling Formations of the Kenai Group, and has permitted revision of current interpretations as to the potential economic minability of the coals. The study has proven that the use of mosaics constructed from low-altitude, oblique 35-mm photographs can be effectively used for planning field work, as a base for locating and plotting sample locations in the field, for studying bedding and structural features, and for resolving correlation problems. This study in general supports the conclusion that coal bed B of Barnes and Cobb (1959) marks the boundary between the Homerian and Clamgulchian floral stages of Wolfe and others (1966) and the approximate contact between the Beluga and Sterling Formations.

Vitrinite content of Beluga Formation and Sterling Formation coals is high and relatively constant. The older, higher-quality coals of the Beluga Formation are richer in liptinites, whereas Sterling Formation coals have higher inertinite contents. The most common microlithotypes present in southern Kenai Peninsula coals are vitrite, clarite, vitrinertite, duroclarite, and carbonmineralites. Carbargilite and carbankerite are the most common carbominerallites. Carbopyrite and carbsilicite are relatively minor. The relatively high carbomineralite content may be indicative of increased Pliocene volcanism in the Alaska Range during deposition of the Sterling Formation. Major oxide and trace-element data of volcanic ash partings and high inertinite bands indicate that coal beds of the Sterling Formation on Cook Inlet and Kachemak Bay sides of the peninsula may be age-correlative.

Beluga Formation coals exhibit an average vitrinite reflectance of 0.37 percent, whereas Sterling Formation coals average 0.32 percent. Beluga Formation coals are lower in moisture and volatile matter contents, higher in fixed carbon and heating value.

Areas with coal-development potential on the southern Kenai Peninsula have been divided into 11 resource blocks (arranged in order of highest to lowest estimated amounts of resources)---Homer, Canyons, Kachemak Bay, Lower Deep Creek, Ninilchik, Plateau, Happy Creek, Anchor Point, Clam Gulch, Upper Deep Creek, and Cape Starichkof. The Homer district of the Kenai coal field contains calculated measured, identified, and hypothetical coal resources of 57.6, 347.2, and 41,550 million short tons, respectively.

Although the cover of Quaternary deposits is thinner in the Homer district than in the Kenai district to the north, it may still be locally restrictive for coal development. Some areas of the Homer district show significant thicknesses of unconsolidated overburden sediments that will hamper exploration drilling and coring operations and present challenging problems for mining. Other areas, such as lower Deep Creek, have shallow overburden, and stripping ratios should be less than 10:1. Although intensive recreational, private and municipal surface use may prevent surface mining in areas of the Homer district, potential for underground recovery exists there.

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APPENDIX A - SAMPLE INFORMATION.

Table Al. Locations of coal-sampling sites, southern Kenai Peninsula.

Id. code	Resource block	Samples	Quadrangle	Township	Range	Section	Latitude (N)	Longitude (W)
SM12	Canyons	12-1	Seldovia D-3	4 S.	10 W.	7	59°50'33"	151°04'20"
SM11	Canyons	11-1	Seldovia D-3	4 S.	10 W.	20	59°48'38"	151°02'38"
		11-2,11-5	Seldovia D-3	4 S.	10 W.	7	59°50'15"	151°03'33"
SM10	Canyons	10-1,10-2,10-3	Seldovia D-3	4 S.	10 W.	18	59°50'03"	151°03'20"
		10-5,10-6,10-7, 10-9	Seldovia D-3	4 S.	10 W.	18	59°50'08"	151°03'25"
SM9	Canyons	9-1	Seldovia D-3	4 S.	10 W.	25	59°47'39"	151°04'58"
		9-2	Seldovia D-3	4 S.	10 W.	25	59°48'13"	151°05'20"
		9-3,9-5,9-7,9-8	Seldovia D-3	4 S.	10 W.	23	59°48'48"	151°06'40"
		9-9,9-10,9-11, 9-13	Seldovia D-3	4 S.	10 W.	23	59°49'02"	151°06'38"
SM8	Port Graham	8-1	Seldovia B-6	9 S.	15 W.	13	59°23'45"	152°53'45"
		8-4	Seldovia B-6	9 S.	15 W.	7	59°25'04"	152°53'00"
SM7	Kachemak Bay	7-1,7-3,7-4,7-6	Seldovia D-3	4 S.	10 W.	3	59°46'22"	151°07'20"
		7-7,7-8,7-9 7-10,7-11,7-13	Seldovia D-3	4 S.	10 W.	36	59°47'22"	151°05'40"
SM6	Kachemak Bay	6-1,6-3	Seldovia C-4	5 S.	12 W.	26	59°42'51"	151°15'28"
		6-5,6-7	Seldovia C-4	5 S.	12 W.	25	59°42'58"	151°14'54"
		6-9	Seldovia C-4	5 S.	12 W.	24	59°43'26"	151°13'52"
		6-11,6-12	Seldovia C-4	5 S.	11 W.	19	59°43'40"	151°13'24"

Table A1 (con.)

Id. code	Resource block	Samples	Quadrangle	Township	Range	Section	Latitude (N)	Longitude (W)
SM5	Kachemak Bay	5-1	Seldovia C-4	5 S.	12 W.	4	59°41'05"	151°15'10"
		5-3	Seldovia C-4	5 S.	12 W.	4	59°41'15"	151°19'30"
		5-4,5-5	Seldovia C-4	6 S.	12 W.	4	59°41'33"	151°18'59"
		5-7,5-8	Seldovia C-4	6 S.	12 W.	34	59°41'42"	151°18'20"
		5-11	Seldovia C-4	6 S.	12 W.	34	59°41'55"	151°17'42"
SM4	Homer	4-1,4-2,4-3 4-4,4-5	Seldovia C-4	6 S.	13 W.	2	59°41'29"	151°25'51"
SM3	Homer	3-1,3-2,3-3 3-5	Seldovia C-4	6 S.	13 W.	10	59°40'41"	151°28'08"
SM2	Homer	2-1	Seldovia C-5	6 S.	14 W.	24	59°38'36"	151°35'21"
		2-3	Seldovia C-5	6 S.	14 W.	24	59°39'17"	151°34'33"
SM1	Homer	1-1,1-2	Seldovia C-4	6 S.	13 W.	14	59°39'10"	151°26'25"
		1-3	Seldovia C-4	6 S.	13 W.	14	59°39'41"	151°26'20"
SM15	Homer	15-1	Seldovia C-5	6 S.	14 W.	16	59°39'38"	151°39'45"
KL	Homer	0002	Seldovia C-5	6 S.	14 W.	15	59°39'25"	151°38'35"
		0005	Seldovia C-5	6 S.	14 W.	15	59°39'25"	151°38'35"
		0006	Seldovia C-6	6 S.	14 W.	8	59°40'18"	151°42'06"

Table A1 (con.)

Id. code	Resource block	Samples	Quadrangle	Township	Range	Section	Latitude (N)	Longitude (W)
KL	Anchor Point	0007	Seldovia C-5	6 S.	14 W.	6	59°40'54"	151°43'45"
		0008	Seldovia C-5	6 S.	14 W.	6	59°40'53"	151°43'40"
		0009	Seldovia C-5	6 S.	14 W.	8	59°40'26"	151°42'28"
		0010	Seldovia C-5	6 S.	14 W.	8	59°40'30"	151°42'38"
		0011	Seldovia C-5	6 S.	14 W.	7	59°40'37"	151°42'55"
		0012	Seldovia C-5	6 S.	14 W.	6	59°40'48"	151°43'26"
		0013	Seldovia C-5	6 S.	15 W.	6	59°41'01"	151°43'57"
		0014	Seldovia C-5	5 S.	15 W.	35	59°41'55"	151°46'20"
		0016	Seldovia C-5	5 S.	15 W.	35	59°42'01"	151°46'38"
		0017	Seldovia C-5	5 S.	15 W.	35	59°42'02"	151°46'40"
		0018	Seldovia C-5	5 S.	15 W.	35	59°42'10"	151°47'02"
		0019	Seldovia C-5	5 S.	15 W.	35	59°42'10"	151°47'02"
		0020	Seldovia C-5	5 S.	15 W.	35	59°42'18"	151°47'25"
SM14	Anchor Point	14-04	Seldovia C-5	5 S.	15 W.	27	59°42'54"	151°48'38"
		14-03	Seldovia C-5	5 S.	15 W.	27	59°42'55"	151°48'40"
		14-02	Seldovia C-5	5 S.	15 W.	27	59°43'04"	151°48'56"
		14-01	Seldovia C-5	5 S.	15 W.	27	59°43'04"	151°48'56"

Table A1 (con.)

Id. code	Resource block	Samples	Quadrangle	Township	Range	Section	Latitude (N)	Longitude (W)
SM13	Cape Starichkof	13-01	Seldovia D-5	4 S.	15 W.	11	59°50'22"	151°48'48"
JL54	Happy Creek	54-01	Seldovia D-5	3 S.	14 W.	25	59°53'21"	151°47'12"
JL56	Happy Creek	56-01	Seldovia D-5	3 S.	14 W.	7	59°55'35"	151°44'53"
JL57	Happy Creek	57-01	Seldovia D-5	3 S.	14 W.	7	59°55'42"	151°44'51"
JL58	Happy Creek	58-01	Seldovia D-5	3 S.	14 W.	7	59°55'50"	151°44'50"
JL59	Happy Creek	59-01	Seldovia D-5	3 S.	14 W.	7	59°55'52"	151°44'50"
JL34	Happy Creek	34-01,34-01	Seldovia D-5	3 S.	14 W.	7	59°56'10"	151°44'40"
JL36	Happy Creek	36-01,36-02	Seldovia D-5	3 S.	14 W.	6	59°56'50"	151°44'16"
JL37	Happy Creek	37-01	Seldovia D-5	3 S.	14 W.	5	59°56'59"	151°44'14"
JL38	Happy Creek	38-01	Seldovia D-5	3 S.	14 W.	5	59°57'06"	151°44'10"
JL39	Happy Creek	39-01, 39-02	Seldovia D-5	2 S.	14 W.	29	59°58'06"	151°43'45"
JL40	Happy Creek	40-01	Seldovia D-5	2 S.	14 W.	29	59°58'15"	151°43'41"

Table Al (con.)

Id. code	Resource block	Samples	Quadrangle	Township	Range	Section	Latitude (N)	Longitude (W)
JL41	Happy Creek	41-01	Seldovia D-5	2 S.	14 W.	29	59°58'25"	151°43'38"
JL42	Happy Creek	42-01	Seldovia D-5	2 S.	14 W.	29	59°58'31"	151°43'37"
JL43	Happy Creek	43-01	Seldovia D-5	2 S.	14 W.	29	59°58'36"	151°43'35"
JL45	Happy Creek	45-01,45-03	Seldovia D-5	2 S.	14 W.	20	59°59'38"	151°43'14"
JL46	Happy Creek	46-01	Seldovia D-5	2 S.	14 W.	17	59°59'51"	151°43'10"
JL47	Happy Creek	47-01	Kenai A-5	2 S.	14 W.	17	60°00'24"	151°42'59"
JL48	Happy Creek	48-01	Kenai A-5	2 S.	14 W.	17	60°00'38"	151°42'55"
JL49	Lower Deep Creek	49-01	Kenai A-5	2 S.	14 W.	4	60°01'32"	151°42'19"
JL50	Upper Deep Creek	50-01	Seldovia D-4	2 S.	12 W.	30	59°58'41"	151°23'50"
GR03	Lower Deep Creek	03-01	Kenai A-5	2 S.	14 W.	14	60°00'18"	151°37'21"
GR02	Lower Deep Creek	02-01	Seldovia D-5	2 S.	13 W.	21	59°59'09"	151°31°58"
GR01	Upper Deep Creek	01-01	Seldovia D-4	2 S.	12 W.	34	59°57'52"	151°29'33"

Table A1 (con.)

Id. code	Resource block	Samples	Quadrangle	Township	Range	Section	Latitude (N)	Longitude (W)
GL03	Plateau	03-01	Seldovia D-4	5 S.	13 W.	3	59°46'35"	151°28'22"
GL02	Lower Deep Creek	02-01	Seldovia D-5	2 S.	13 W.	30	59°48'42"	151°33'54"
GL01	Lower Deep Creek	01-01	Seldovia D-5	2 S.	13 W.	28	59°58'54"	151°31'44"
JL01	Lower Deep Creek	01-02	Kenai A-5	2 S.	14 W.	4	60°02'12"	151°41'34"
JL02	Ninilchik	02-01	Kenai A-5	1 S.	14 W.	27	60°03'41"	151°39'11"
JL03	Ninilchik	03-01	Kenai A-5	1 S.	14 W.	27	60°03'43"	151°39'10"
JL05	Ninilchik	05-01, 05-02	Kenai A-5	1 S.	14 W.	26	60°03'53"	151°39'00"
JL06	Ninilchik	06-01	Kenai A-5	1 S.	14 W.	26	60°03'58"	151°38'55"
JL07	Ninilchik	07-01	Kenai A-5	1 S.	14 W.	26	60°04'00"	151°38'53"
JL08	Ninilchik	08-01	Kenai A-5	1 S.	14 W.	26	60°04'05"	151°38'50"
JL09	Ninilchik	09-01	Kenai A-5	1 S.	14 W.	20	60°04'07"	151°38'46"
JL13	Ninilchik	13-01, 13-02	Kenai A-5	1 S.	14 W.	23	60°04'55"	151°37'42"
JL14	Ninikchik	14-01	Kenai A-5	1 S.	14 W.	14	60°05'10"	151°37'25"
JL15	Ninilchik	15-01	Kenai A-5	1 S.	14 W.	13	60°05'49"	151°36'41"
JL16	Ninilchik	16-01	Kenai A-5	1 S.	14 W.	12	60°05'55"	151°36'27"
JL18	Ninilchik	18-01	Kenai A-5	1 S.	13 W.	5	60°07'08"	151°33'50"

Table A1 (con.)

Id. code	Resource block	Samples	Quadrangle	Township	Range	Section	Latitude (N)	Longitude (W)
JL19	Ninilchik	19-01	Kenai A-5	1 S.	13 W.	5	60°07'33"	151°33'02"
JL21	Ninilchik	21-01	Kenai A-5	1 N.	13 W.	33	60°07'55"	151°32'11"
JL22	Ninilchik	22-01	Kenai A-5	1 N.	13 W.	27	60°08'34"	151°31'14"
JL23	Ninilchik	23-01	Kenai A-5	1 N.	13 W.	27	60°09'21"	151°30'10"
JL25	Clam Gulch	25-01, 25-03	Kenai A-4	1 N.	13 W.	14	60°10'24"	151°28'50"
JL26	Clam Gulch	26-01	Kenai A-4	1 N.	13 W.	14	60°10'32"	151°28'39"
JL27	Clam Gulch	27-01	Kenai A-4	1 N.	13 W.	13	60°10'53"	151°28'10"
JL29	Glam Gulch	29-01, 29-02, 29-04	Kenai A-4	1 N.	13 W.	12	60°11'44"	151°26'48"
JL30	Clam Gulch	30-01	Kenai A-4	1 N.	12 W.	6	60°12'13"	151°26'10"
JL31	Clam Gulch	31-01, 31-02	Kenai A-4	1 N.	12 W.	6	60°12'35"	151°25'35"
JL32	Clam Gulch	32-01	Kenai A-4	2 N.	12 W.	32	60°13'33"	151°24'30"
JL33	Clam Gulch	33-01	Kenai A-4	2 N.	12 W.	29	60°14'16"	151°24'02"
JL51	Clam Gulch	51-01	Kenai A-4	2 N.	12 W.	29	60°14'33"	151°23'52"
JL52	Clam Gulch	52-01	Kenai B-4	2 N.	12 W.	20	60°15'22"	151°23'24"

Table A2. Locations of clastic-rock sampling sites, southern Kenai Peninsula.

Id. code	Resource block	Samples[1]	Quadrangle	Township	Range	Section	Latitude (N)	Longitude (W)
SM12	Canyons	12-2 (s) 12-3 (s) 12-4 (p)* 12-5 (s)	Seldovia D-3	4 S.	10 W.	7	59°50'33"	151°04'20"
SM11	Canyons	11-3 (p)* 11-4 (o)	Seldovia D-3	4 S.	10 W.	7	59°50'15"	151°03'33"
SM10	Canyons	10-4 (s)	Seldovia D-3	4 S.	10 W.	18	59°50'08"	151°03'25"
		10-6 (p)*, 10-08 (a)	Seldovia D-3	4 S.	10 W.	18	59°50'08"	151°03'25"
SM9	Canyons	9-4 (p)*, 9-6 (s)	Seldovia D-3	4 S.	10 W.	23	59°48'48"	151°06'40"
		9-12 (p)*, 9-14 (s)	Seldovia D-3	4 S.	10 W.	23	59°49'02"	151°06'38"
SM8	Port Graham	8-2 (p)*	Seldovia B-6	9 S.	15 W.	13	59°23'45"	152°53'45"
		8-3 (p)*	Seldovia B-6	9 S.	15 W.	7	59°25'04"	152°53'00"
SM7	Kachemak Bay	7-2 (p)*, 7-5 (s)	Seldovia D-3	4 S.	10 W.	3	59°46'22"	151°07'20"
		7-12 (p)*, 7-14 (s)	Seldovia D-3	4 S.	10 W.	36	59°42'22"	151°05'40"

Table A2 (con.)

Id. code	Resource block	Samples[1]	Quadrangle	Township	Range	Section	Latitude (N)	Longitude (W)
SM6	Kachemak Bay	6-2(a)	Seldovia C-4	5 S.	12 W.	26	59°42'51"	151°15'28"
		6-4 (s), 6-6 (p)*	Seldovia C-4	5 S.	12 W.	25	59°42'58"	151°14'54"
		6-8 (p)*, 6-10 (s)	Seldovia C-4	5 S.	12 W.	24	59°43'26"	151°13'52"
SM5	Kachemak Bay	5-2 (p)*	Seldovia C-4	5 S.	12 W.	4	59°41'05"	151°15'10"
		5-6 (a)	Seldovia C-4	6 S.	12 W.	4	59°41'33"	151°18'59"
		5-9 (p)*, 5-10 (f)	Seldovia C-4	6 S.	12 W.	34	59°41'42"	151°18'20"
		5-12 (s)	Seldovia C-4	6 S.	12 W.	34	59°41'55"	151°17'42"
SM4	Homer	4-6 (s)	Seldovia C-4	6 S.	13 W.	2	59°41'29"	151°25'51"
SM3	Homer	3-4 (s), 3-6 (p)*	Seldovia C-4	6 S.	13 W.	10	59°40'41"	151°28'08"
SM2	Homer	2-2 (s)	Seldovia C-5	6 S.	14 W.	24	59°38'36"	151°35'21"
SM1	Homer	1-4 (s)	Seldovia C-4	6 S.	13 W.	14	59°39'41"	151°26'20"
KL	Homer	0002 (o)	Seldovia C-5	6 S.	14 W.	15	59°39'25"	151°38'35"
		0003 (o)	Seldovia C-5	6 S.	14 W.	15	59°39'25"	151°38'55"
KL	Anchor Point	0007 (p)*	Seldovia C-5	6 S.	14 W.	6	59°40'54"	151°43'45"
		0014 (p)*	Seldovia C-5	5 S.	15 W.	35	59°41'55"	151°46'20"
		0019 (p)*	Seldovia C-5	5 S.	15 W.	35	59°42'10"	151°47'02"
		05-2 (s)	Seldovia C-5	6 S.	14 W.	8	59°40'30"	151°42'38"
		05-8 (o)	Seldovia C-5	5 S.	15 W.	35	59°41'55"	151°46'20"

Table A2 (con.)

Id. code	Resource block	Samples[1]	Quadrangle	Township	Range	Section	Latitude (N)	Longitude (W)
SM14	Anchor Point	14-5 (s)	Seldovia C-5	5 S.	15 W.	27	59°42'54"	151°48'38"
SM13	Cape Starichkof	13-2 (s)	Seldovia C-5	4 S.	15 W.	11	59°50'22"	151°48'48"
JL55	Happy Creek	55-01 (o)	Seldovia D-5	3 S.	14 W.	18	59°55'29"	151°44'55"
JL54	Happy Creek	54-02 (p)*	Seldovia D-5	3 S.	15 W.	25	59°53'21"	151°47'12"
JL34	Happy Creek	34-03 (p)*	Seldovia D-5	3 S.	14 W.	7	59°56'10"	151°44'40"
JL35	Happy Creek	35-01 (s)	Seldovia D-5	3 S.	14 W.	7	59°56'20"	151°44'30"
JL39	Happy Creek	39-03 (p)*	Seldovia D-5	2 S.	14 W.	29	59°58'06"	151°43'45"
JL41	Happy Creek	41-02 (s)	Seldovia D-5	2 S.	14 W.	29	59°58'25"	151°43'38"
JL42	Happy Creek	42-02 (s)	Seldovia D-5	2 S.	14 W.	29	59°58'31"	151°43'37"
JL44	Happy Creek	44-01 (s)	Seldovia D-5	2 S.	14 W.	20	59°59'15"	151°43'22"
JL45	Happy Creek	45-02 (p)*	Seldovia D-5	2 S.	14 W.	20	59°59'38"	151°43'14"
JL47	Happy Creek	47-02 (o)	Kenai A-5	2 S.	14 W.	17	60°00'24"	151°42'59"
JL49	Lower Deep Creek	49-02 (p)*	Kenai A-5	2 S.	14 W.	4	60°01'32"	151°42'19"
JL50	Upper Deep Creek	50-02 (o)	Seldovia D-4	2 S.	12 W.	30	59°58'41"	151°23'50"
JL01	Lower Deep Creek	01-01 (p)*	Kenai A-5	2 S.	14 W.	4	60°02'12"	151°41'34"

Table A2 (con.)

Id. code	Resource block	Samples[1]	Quadrangle	Township	Range	Section	Latitude (N)	Longitude (W)
JL03	Ninilchik	03-02 (s)	Kenai A-5	1 S.	14 W.	27	60°03'43"	151°39'10"
JL04	Ninilchik	04-01 (p)*	Kenai A-5	1 S.	14 W.	27	60°03'47"	151°39'08"
JL10	Ninilchik	10-01 (p)*	Kenai A-5	1 S.	14 W.	23	60°04'07"	151°38'45"
JL12	Ninilchik	12-01 (o)	Kenai A-5	1 S.	14 W.	23	60°04'41"	151°38'02"
JL15	Ninilchik	15-02 (p)*	Kenai A-5	1 S.	14 W.	13	60°05'49"	151°36'41"
JL17	Ninilchik	17-01 (o)	Kenai A-5	1 S.	13 W.	5	60°07'05"	151°33'55"
JL18	Ninilchik	18-02 (s)	Kenai A-5	1 S.	13 W.	5	60°07'08"	151°33'50"
JL19	Ninilchik	19-02 (p)*	Kenai A-5	1 S.	13 W.	5	60°07'33"	151°33'02"
JL20	Ninilchik	20-01 (s), 20-02 (s)	Kenai A-5	1 N.	13 W.	33	60°07'37"	151°32'52"
JL22	Ninilchik	22-02 (o)	Kenai A-5	1 N.	13 W.	27	60°08'34"	151°31'14"
JL24	Ninilchik	24-01 (o)	Kenai A-4	1 N.	13 W.	23	60°10'01"	151°29'18"
JL25	Clam Gulch	25-02 (p)*, 25-04 (o)	Kenai A-4	1 N.	13 W.	14	60°10'24"	151°28'50"
JL28	Clam Gulch	28-01 (a), 28-02 (o)	Kenai A-4	1 N.	13 W.	13	60°10'58"	151°28'00"
JL29	Clam Gulch	29-03 (o)	Kenai A-4	1 N.	13 W.	12	60°11'44"	151°26'48"
JL31	Clam Gulch	31-03 (o), 31-04 (p)*	Kenai A-4	1 N.	12 W.	6	60°12'35"	151°25'35"

Table A2 (con.)

Id. code	Resource block	Samples[1]	Quadrangle	Township	Range	Section	Latitude (N)	Longitude (W)
JL51	Clam Gulch	51-03 (o)	Kenai A-4	2 N.	12 W.	29	60°14'33"	151°23'52"
JL52	Clam Gulch	52-02 (p)*, 52-03 (a)	Kenai B-4	2 N.	12 W.	20	60°15'22"	151°23'24"
JL53	Clam Gulch	53-01 (s)	Kenai B-4	2 N.	12 W.	17	60°15'32"	151°23'22"

[1] (s) = sandstone samples; (a) = ash samples; (f) = fossil; (p)* = samples submitted for palynology and overburden analysis; and (o) = other samples.

Table A3. Palynology samples.

Sample no.	Quarter/quarter location	Section	Township	Range	Latitude (N)	Longitude (W)	Comments
86SM03-6	NW¼, NW¼, NE¼	10	6 S.	13 W.	59°40'41"	151°28'08"	Silty carbonaceous claystone directly above a 1.3-m thick coal (86SM03-5) near the top of the measured Bear Creek Canyon section in Homer Escarpment.
86SM05-2	NE¼, NW¼, SW¼	4	6 S.	12 W.	59°41'05"	151°15'19"	A 0.1-m thick carbonaceous shale above a 0.1-m carbonaceous siltstone and a 0.35-m coal (86SM05-1). Sample taken near the base of the beachcrop 1.6 km east of Fritz Creek on Kachemak Bay.
86SM05-9	SW¼, SE¼, SW¼	34	5 S.	12 W.	59°41'42"	151°18'20"	Sampled stratum of variable thickness, but 0.12-m thick at sample site. It is a carbonaceous siltstone parting in a 1.0-m thick coal (86SM05-8). Sample taken in beachcrop 3.6 km east of Fritz Creek just west of a covered interval on Kachemak Bay.
86SM06-6	SW¼, SE¼, NW¼	25	5 S.	12 W.	59°42'58"	151°14'54"	Siltstone roofrock above coal bed B (86SM06-5, which is 1.35-m thick). Sample taken at beach level just west of McNeil Canyon on Kachemak Bay. B bed is the likely boundary between the Homerian and Clamgulchian floral stages.

Table A3. (con.)

Sample no.	Quarter/quarter location	Section	Township	Range	Latitude (N)	Longitude (W)	Comments
86SM06-8	SE¼, SE¼, SE¼	24	5 S.	12 W.	59°43'26"	151°13'52"	A 0.20-m thick siltstone seatrock beneath a 1.35-m coal bed (bed D---86SM06-9). Sample taken near base of beachcrop 0.8 km east of McNeil Canyon on Kachemak Bay.
86SM07-2	SE¼, SE¼, NE¼	3	5 S.	11 W.	59°46'22"	151°07'20"	A siltstone seatrock beneath a 0.66-m thick coal (bed H---86SM07-3). Sample taken near the base of a large beachcrop approximately 120 m high, just west of Falls Creek near the upper reaches of Kachemak Bay.
86SM07-12	NE¼, SE¼, NW¼	36	4 S.	11 W.	59°47'22"	151°05'40"	A siltstone seatrock beneath a 1.5-m coal bed (bed M---86SM07-13). Sample taken in a small canyon directly west of Swift Creek near the upper part of Kachemak Bay.

Table A3. (con.)

Sample no.	Quarter/quarter location	Section	Township	Range	Latitude (N)	Longitude (W)	Comments
86SM08-2	NW¼, NW¼, SE¼	13	9 S.	15 W.	59°23'45"	152°53'45"	Gray siltstone just west of a talus slope containing pilings from the old Port Graham Mine (circa 1855). Coal float from vicinity also sampled (86SM08-1). Sample taken just above the beach near the pilings at Coal Cove, southern Kenai Peninsula.
86SM08-3	NE¼, NW¼, NE¼	7	9 S.	15 W.	59°25'04"	152°53'00"	A basal clay below a 0.98-m coal bed (86SM)8-4) approximately 20 m above beach. Sample taken from the only Tertiary exposure south of Pt. Pogibshi and north of Dangerous Cape on the Cook Inlet side of the southern Kenai Peninsula.
86SM09-4	NE¼, NE¼, SE¼	23	4 S.	10 W.	59°48'48"	151°00'48"	Siltstone seatrock about 10-m thick below N bed (86SM09-5). Coal bed approximately 2-m thick but contains numerous siltstone partings. Sample taken directly below coal bed in Swift Creek Canyon, upper Kachemak Bay.

Table A3. (con.)

Sample no.	Quarter/quarter location	Section	Township	Range	Latitude (N)	Longitude (W)	Comments
86SM9-12	NW¼, SE¼, NE¼	23	4 S.	10 W.	59°49'02"	151°06'38"	A 0.5-m thick, medium-gray, carbonaceous siltstone that underlies a 1.7-m thick coal bed (bed U---86SM09-13). Sample taken near the top of the Tertiary section in upper Swift Creek Canyon area, Kachemak Bay.
86SM10-6	NE¼, NW¼, NE¼	18	4 S.	10 W.	59°50'08"	151°03'25"	Dark-colored carbonaceous siltstone roofrock of a 1.1-m thick coal bed (86SM10-5). Sample taken in Fox Creek Canyon 4.8 km upstream from its mouth at the head of Kachemak Bay.
86SM11-3	SW¼, SW¼, SE¼	7	4 S.	10 W.	59°50'15"	151°03'33"	A 0.15-m thick carbonaceous shale roofrock of a 0.66-m thick coal bed (86SM11-2). Sample taken in exposure directly west and upcanyon from where 86SM10-6 was taken. Also in Fox Creek Canyon about 4.8 km up from its mouth.
86SM12-4	NE¼, NW¼, SW¼	7	4 S.	10 W.	59°50'33"	151°04'20"	A thin (0.012-m thick) carbonaceous shale directly above a 0.38-m thick coal. Sample taken near the top of the Fox Creek section about 6.4 km up from the mouth of the canyon. Thin coals here mark the end of organic deposition after which the Sterling Formation turns almost totally sandy.

Table A3. (con.)

Sample no.	Quarter/quarter location	Section	Township	Range	Latitude (N)	Longitude (W)	Comments
86JL54-02	SW¼, SE¼, NW¼	25	3 S.	15 W.	59°53'19"	151°47'10"	A 1.5-m thick claystone from between two thin (one 0.05-m thick and one 0.4-0.5 m thick) coals beds. Sample taken at the mouth of Stariski Creek north of Cape Starichkof.
86JL34-03	SE¼, NW¼, NE¼	7	3 S.	14 W.	59°56'09"	151°44'43"	A 0.3-m thick, very light gray claystone between coal beds 34-02 and 34-01 (each about 0.4-m thick). Sample from just north of Happy Creek.
86JL39-03	SW¼, SE¼, SW¼	29	2 S.	14 W.	59°58'05"	151°43'50"	A 0.2-m thick, brown, silty claystone from between a 0.3-m thick coal (above) and a 0.5-m thick coal (below). Sample taken about 4 km north of Happy Creek and 0.8 km south of an unnamed creek.
86JL45-02	S½, NW¼, NE¼	20	2 S.	14 W.	59°59'38"	151°43'20"	A very light gray silty claystone. Sample taken near the bottom of a 3.8-m thick stratum that separates a 2-cm thick coal lense (above) and 0.95-m thick coal (below). Located about 6.4 km north of Happy Creek.

Table A3. (con.)

Sample no.	Quarter/quarter location	Section	Township	Range	Latitude (N)	Longitude (W)	Comments
86JL49-02	S½, SW¼, SW¼	4	2 S.	14 W.	60°01'32"	151°42'19"	A 3-m thick light gray claystone with 2-cm thick coal lenses. Sample taken near the top of the claystone unit just below a 0.4-m thick coal bed (49-01) and above a 0.15-m thick vitreous coal lense. Located about 0.8 km south of Deep Creek near Cape Ninilchik.
86JL01-01	SW¼, NW¼, NE¼	4	2 S.	14 W.	60°02'12"	151°41'34"	A 4.5-m thick light gray carbonaceous claystone with abundant woody fragments up to 1-cm diameter. Sample taken above a 1.7-m thick carbonaceous shale with coaly partings to 1-cm thick, below a 3-m thick siltstone-sandy siltstone unit, and about 11 m down from the top of the exposure. Located between the Ninilchik River and Deep Creek.

Table A3. (con.)

Sample no.	Quarter/quarter location	Section	Township	Range	Latitude (N)	Longitude (W)	Comments
86JL04-01	E½, SE¼, NE¼	27	1 S.	14 W.	60°03'49"	151°39'08"	A 1.6-m thick, purplish-gray siltstone. Sample taken 1-m down in the bed between 0.2-m thick lignite (above) and 0.1-m thick boney coal (below). Located about 300 m north of Ninilchik.
86JL10-01	SE¼, SW¼, SW¼	23	1 S.	14 W.	60°04'11"	151°38'42"	A 0.9-m very light gray claystone. Sample taken below a 3.6 m thick sandstone with coalified logs and branches and above a 4.1-m alternating claystone and sandstone. Located about 2.4 km north of Ninilchik.
86JL15-02	N½, NE¼, NW¼	13	1 S.	14 W.	60°05'50"	151°36'40"	A 0.9-m thick claystone and siltstone sampled between two coal beds (a 0.1-m thick bed above and an 0.8 km thick bed below). Located just north of access to beach.
86JL19-02	NW¼, NW¼, NE¼	5	1 S.	13 W.	60°07'34"	151°33'01"	A 0.4-m thick, very light gray claystone. Sampled between two coal layers (a 0.05-m thick coal and a 0.35-m thick coal). Located about 2.4 km south of fish house access.

Table A3. (con.)

Sample no.	Quarter/quarter location	Section	Township	Range	Latitude (N)	Longitude (W)	Comments
86JL25-02	E½, SW¼, SE¼	14	1 N.	13 W.	60°10'23"	151°28'49"	A 6.3-m thick, very light gray claystone with minor sandstone. Sampled from above a series of thin coal beds and below a 1.3-m thick coal (25-01). Located adjacent to a fault about 0.8 km north of Corea Creek.
86JL31-04	NW¼, SW¼, NE¼	6	1 N.	12 W.	60°12'35"	151°25'36"	Very light gray claystone 'boudins' from just north of a fault about 0.5 mi north of Falls Creek. Sampled between a 1.2-m thick coal bed (31-01) and a 0.5-m thick coal bed (31-02).
86JL52-02	NW¼, NE¼, NE¼	20	2 N.	12 W.	60°15'21"	151°23'27"	Sample from base of a 6.3-m thick bed of alternating siltstone and sandstone, and directly above a 0.7-m thick boney coal (52-01). Located about 1.6 km north of Clam Gulch.
KL0007	NE¼, SE¼, SW¼	6	6 S.	14 W.	59°40'49"	151°43'35"	A 0.1-m thick parting of dark-gray carbonaceous shale. Sample taken about 0.1 m below the top of a 1.4-m thick coal. Located a little over 1.7 km northwest of Diamond Creek near Homer in beachcrop.

Table A3. (con.)

Sample no.	Quarter/quarter location	Section	Township	Range	Latitude (N)	Longitude (W)	Comments
KL0014	SE¼, NW¼, SE¼	25	6 S.	14 W.	59°41'48"	151°46'18"	A 0.6-m thick parting of medium-light gray, hackly-weathering carbonaceous shale with scattered plant fragments. Sample taken 0.4 m down from the top of a 1-m thick coal bed. Located about 4.8 km northwest of Diamond Creek near Homer in beachcrop.
KL0019	E½, SE¼, NW¼	35	6 S.	14 W.	59°42'05"	151°47'06"	A 0.08-m thick, medium-dark-gray, carbonaceous, sandy siltstone parting in 1.0 m thick coal. Located in beachcrop 3.2 km southeast of Mutnaia Gulch, halfway between Anchor Point and Homer.

APPENDIX B.
Coal quality, petrologic, and geochemical data.

Table B1. Proximate analysis of Homer district, Kenai coal field samples.

Sample no.	Basis*	Moisture (%)	Ash (%)	VM (%)	FC (%)	Heat value Btu/lb	Total sulfur (%)
SM01-01	1	19.04	19.51	32.22	29.23	8520.	0.39
	2	19.31	19.45	32.11	29.13	8492.	0.38
	3			50.82	49.18	10854.	
SM01-02	1	20.24	9.20	34.04	36.52	8465.	0.42
	2	20.21	9.20	34.06	36.53	8468.	0.42
	3			47.51	52.49	9422.	
SM01-03	1	20.66	16.54	32.11	30.70	7605.	0.36
	2	19.46	16.79	32.59	31.16	7721.	0.37
	3			49.76	50.24	9301.	
SM02-01	1	21.38	8.36	35.81	34.45	8356.	0.31
	2	21.33	8.37	35.83	34.48	8362.	0.31
	3			50.34	49.66	9206.	
SM02-03	1	25.98	5.47	36.56	31.98	7425.	0.43
	2	23.55	5.65	37.76	33.03	7669.	0.45
	3			52.92	47.08	7904.	
SM03-01	1	23.84	21.36	29.16	25.64	6551.	0.46
	2	ISS	ISS	ISS	ISS	ISS	ISS
	3			51.25	48.75	8568.	
SM03-02	1	28.94	7.16	33.95	29.96	7380.	0.32
	2	23.63	7.69	36.48	32.20	7932.	0.34
	3			52.55	47.45	8014.	
SM03-03	1	28.27	12.98	31.32	27.43	6839.	0.27
	2	23.61	13.82	33.35	29.22	7283.	0.29
	3			52.22	47.78	7980.	
SM03-05	1	26.53	6.71	35.84	30.92	7742.	0.23
	2	24.28	6.92	36.94	31.87	7979.	0.24
	3			53.19	46.81	8361.	
SM04-01	1	29.93	19.58	27.73	22.76	5835.	0.27
	2	ISS	ISS	ISS	ISS	ISS	ISS
	3			53.06	46.94	7439.	
SM04-02	1	28.25	22.22	27.80	21.74	5647.	0.45
	2	23.03	23.83	29.82	23.32	6057.	0.49
	3			53.99	46.01	7477.	

Table B1 (con.)

Sample no.	Basis*	Moisture (%)	Ash (%)	VM (%)	FC (%)	Heat value Btu/lb	Total sulfur (%)
SM04-03	1	29.62	5.52	34.31	30.55	7535.	0.30
	2	24.55	5.92	36.78	32.75	8078.	0.32
	3			52.46	47.54	8025.	
SM04-04	1	24.72	37.31	23.08	14.89	6859.	0.28
	2	21.84	38.74	23.96	15.46	7121.	0.29
	3			56.46	43.54	11640.	
SM04-05	1	28.89	18.03	29.78	23.30	6133.	0.36
	2	20.72	20.10	33.20	25.97	6838.	0.40
	3			54.52	45.48	7654.	
SM05-01	1	12.85	44.33	28.52	14.30	5207.	0.42
	2	13.45	44.02	28.32	14.20	5171.	0.42
	3			62.68	37.32	10171.	
SM05-03	1	20.10	25.91	30.39	23.60	6567.	0.54
	2	19.06	26.25	30.79	23.90	6652.	0.54
	3			54.02	45.98	9192.	
SM05-04	1	21.03	22.41	29.92	26.64	6734.	0.64
	2	19.92	22.73	30.34	27.01	6829.	0.65
	3			50.87	49.13	8945.	
SM05-05	1	18.27	35.13	26.61	19.99	5454.	0.61
	2	18.38	35.08	26.58	19.96	5446.	0.61
	3			53.51	46.49	8897.	
SM05-07	1	21.30	16.85	32.55	29.30	7586.	0.38
	2	20.92	16.93	32.71	29.44	7622.	0.38
	3			51.25	48.75	9316.	
SM05-08	1	22.07	13.16	34.78	29.98	8177.	0.45
	2	20.84	13.37	35.33	30.46	8306.	0.45
	3			52.70	47.30	9566.	
SM05-11	1	21.07	18.10	37.04	23.79	7792.	0.41
	2	20.16	18.31	37.47	24.06	7882.	0.41
	3			59.65	40.35	9735.	
SM06-01	1	22.07	13.00	33.01	31.92	7849.	0.43
	2	20.89	13.20	33.51	32.40	7968.	0.44
	3			49.78	50.22	9164.	

Table B1 (con.)

Sample no.	Basis*	Moisture (%)	Ash (%)	VM (%)	FC (%)	Heat value Btu/lb	Total sulfur (%)
SM06-03	1	21.71	9.58	35.44	33.27	8461.	0.33
	2	21.32	9.63	35.62	33.44	8503.	0.33
	3			50.86	49.14-	9461.	
SM06-05	1	22.35	16.21	32.80	28.64	7812.	0.53
	2	22.06	16.27	32.93	28.75	7841.	0.53
	3			52.06	47.94	9513.	
SM06-07	1	22.99	11.86	34.55	30.60	7779.	0.39
	2	22.71	11.91	34.68	30.71	7807.	0.40
	3			52.12	47.88	8951.	
SM06-09	1	24.15	5.84	36.13	33.89	7563.	0.21
	2	24.25	5.83	36.08	33.84	7553.	0.21
	3			51.17	48.83	8084.	
SM06-11	1	18.43	17.68	34.13	29.76	7455.	0.34
	2	19.09	17.54	33.85	29.52	7395.	0.33
	3			52.05	47.95	9259.	
SM06-12	1	22.95	6.24	37.66	33.15	8478.	0.40
	2	21.19	6.38	38.52	33.91	8672.	0.41
	3			52.73	47.27	9107.	
SM07-01	1	28.17	14.00	30.80	27.04	6829.	0.39
	2	23.51	14.91	32.79	28.79	7272.	0.41
	3			52.04	47.96	8075.	
SM07-03	1	26.09	22.35	28.32	23.24	6005.	0.38
	2	23.02	23.28	29.50	24.20	6254.	0.40
	3			52.83	47.17	7967.	
SM07-04	1	25.28	7.82	35.95	30.95	7901.	0.37
	2	24.44	7.91	36.35	31.30	7990.	0.37
	3			53.15	46.85	8648.	
SM07-06	1	25.23	7.25	37.30	30.22	6940.	0.38
	2	25.11	7.26	37.36	30.27	6951.	0.38
	3			54.72	45.28	7545.	
SM07-07	1	27.31	14.95	30.83	26.90	6714.	0.43
	2	22.76	15.89	32.76	28.59	7134.	0.46
	3			52.11	47.89	8040.	

Table B1 (con.)

Sample no.	Basis*	Moisture (%)	Ash (%)	VM (%)	FC (%)	Heat value Btu/lb	Total sulfur (%)
SM07-08	1	27.23	18.27	30.14	24.36	6518.	0.46
	2	22.08	19.56	32.27	26.08	6979.	0.50
	3			53.69	46.31-	8163.	
SM07-09	1	30.72	5.49	35.22	28.57	7281.	0.21
	2	25.14	5.93	38.06	30.87	7867.	0.23
	3			54.80	45.20	7750.	
SM07-10	1	28.38	11.31	33.63	26.68	6784.	0.30
	2	24.90	11.86	35.26	27.98	7114.	0.32
	3			54.88	45.12	7751.	
SM07-11	1	22.92	9.19	37.65	30.25	7668.	0.40
	2	21.61	9.34	38.29	30.76	7798.	0.41
	3			54.80	45.20	8533.	
SM07-13	1	18.67	5.97	43.74	31.63	7759.	0.28
	2	19.17	5.93	43.47	31.43	7711.	0.28
	3			57.67	42.33	8307.	
SM08-01	1	18.75	14.42	32.62	34.21	8512.	0.62
	2	17.07	14.72	33.29	34.92	8688.	0.63
	3			47.60	52.40	10124.	
SM08-04	1	21.23	14.85	31.39	32.53	7869.	0.58
	2	19.31	15.21	32.15	33.33	8061.	0.60
	3			47.82	52.18	9412.	
SM09-01	1	32.43	5.71	34.32	27.54	7072.	0.29
	2	26.63	6.20	37.27	29.90	7680.	0.31
	3			55.04	44.96	7549.	
SM09-02	1	29.50	14.63	30.66	25.20	6548.	0.60
	2	24.94	15.58	32.65	26.83	6972.	0.63
	3			53.60	46.40	7810.	
SM09-03	1	27.99	25.31	27.18	19.52	5264.	0.40
	2	20.64	27.90	29.95	21.51	5801.	0.45
	3			55.74	44.26	7299.	
SM09-05	1	28.44	21.74	28.69	21.13	5622.	0.38
	2	22.50	23.54	31.07	22.88	6089.	0.41
	3			55.60	44.40	7393.	

Table B1 (con.)

Sample no.	Basis*	Moisture (%)	Ash (%)	VM (%)	FC (%)	Heat value Btu/lb	Total sulfur (%)
SM09-07	1	17.16	9.46	43.03	30.36	7711.	0.28
	2	19.78	9.16	41.67	29.40	7467.	0.27
	3			58.07	41.93	8609.	
SM09-08	1	30.95	5.76	36.71	26.58	7152.	0.22
	2	25.27	6.23	39.73	28.77	7740.	0.24
	3			57.59	42.41	7637.	
SM09-09	1	22.50	8.08	41.04	28.27	7035.	0.29
	2	22.78	8.06	40.95	28.21	7018.	0.29
	3			58.70	41.30	7724.	
SM09-10	1	21.74	7.87	42.20	28.19	7600.	0.31
	2	21.40	7.91	42.38	28.31	7633.	0.31
	3			59.47	40.53	8323.	
SM09-11	1	25.55	18.69	33.65	22.11	6109.	0.33
	2	21.61	19.68	35.43	23.28	6432.	0.35
	3			58.85	41.15	9187.	
SM09-13	1	18.45	17.27	38.56	25.72	7439.	0.31
	2	20.29	16.88	37.69	25.14	7271.	0.30
	3			58.85	41.15	9187.	
SM10-01	1	33.46	7.74	32.81	25.99	6686.	0.33
	2	29.20	8.24	34.91	27.66	7114.	0.35
	3			55.17	44.83	7311.	
SM10-02	1	32.10	12.07	31.24	24.59	6017.	0.26
	2	27.48	12.89	33.37	26.26	6426.	0.28
	3			54.95	45.05	6940.	
SM10-03	1	26.76	13.53	34.34	25.37	6692.	0.24
	2	24.28	13.98	35.51	26.23	6918.	0.25
	3			56.50	43.50	7864.	
SM10-05	1	28.84	18.14	31.54	21.48	5779.	0.29
	2	24.37	19.28	33.52	22.83	6142.	0.31
	3			58.02	41.98	7222.	
SM10-07	1	29.20	12.35	33.59	24.86	6351.	0.26
	2	25.80	12.95	35.20	26.05	6656.	0.28
	3			56.52	43.48	7352.	
SM10-09	1	16.97	19.96	37.99	25.08	6957.	0.42
	2	18.34	19.63	37.36	24.67	6842.	0.42
	3			58.89	41.11	8919.	

Table B1 (con.)

Sample no.	Basis*	Moisture (%)	Ash (%)	VM (%)	FC (%)	Heat value Btu/lb	Total sulfur (%)
SM11-01	1	25.09	7.87	36.07	30.97	7172.	0.28
	2	24.51	7.93	36.35	31.21	7227.	0.28
	3			53.22	46.78	7854.	
SM11-02	1	27.96	15.17	33.79	23.07	6466.	0.31
	2	25.06	15.78	35.15	24.00	6727.	0.32
	3			58.28	41.72	7765.	
SM11-05	1	20.35	20.51	35.96	23.18	6345.	0.53
	2	20.46	20.48	35.91	23.15	6336.	0.53
	3			59.34	40.66	8198.	
SM12-01	1	29.76	17.09	32.34	20.80	6014.	0.47
	2	25.97	18.02	34.09	21.92	6338.	0.49
	3			59.50	40.50	7411.	
SM13-01	1	24.60	10.92	31.07	33.41	7736.	2.19
	2	22.61	11.21	31.89	34.29	7940.	2.25
	3			47.02	52.98	8814.	
SM14-01	1	20.90	6.75	38.71	33.64	8326.	0.42
	2	21.17	6.72	38.58	33.53	8297.	0.42
	3			53.02	46.98	8997.	
SM14-02	1	23.16	10.66	33.84	32.34	7944.	0.37
	2	21.65	10.87	34.50	32.98	8101.	0.38
	3			50.29	49.71	9003.	
SM14-03	1	19.74	18.31	32.25	29.70	7333.	0.84
	2	19.47	18.37	32.36	29.80	7357.	0.84
	3			50.50	49.50	9192.	
SM14-04	1	21.28	12.80	34.75	31.18	8033.	0.49
	2	21.43	12.77	34.68	31.12	8017.	0.49
	3			51.72	48.28	9354.	
SM15-01	1	20.54	12.87	35.60	31.00	7988.	0.38
	2	21.91	12.65	34.98	30.46	7850.	0.38
	3			52.50	47.50	9309.	
KL0002	1	21.52	9.47	37.75	31.25	8514.	0.41
	2	22.33	9.38	37.36	30.93	8426.	0.41
	3			54.04	45.96	9509.	
KL0005	1	21.85	31.69	25.32	21.14	5369.	0.45
	2	20.48	32.25	25.76	21.51	5463.	0.45
	3			51.09	48.91	8248.	

Table B1 (con.)

Sample no.	Basis*	Moisture (%)	Ash (%)	VM (%)	FC (%)	Heat value Btu/lb	Total sulfur (%)
KL0006	1	19.20	19.42	32.01	29.37	7338.	0.39
	2	20.25	19.17	31.59	28.99	7243.	0.38
	3			50.54	49.46-	9337.	
KL0007	1	17.36	26.18	28.88	27.58	6835.	0.39
	2	17.79	26.04	28.73	27.44	6799.	0.38
	3			48.72	51.28	9604.	
KL0008	1	19.71	24.04	28.70	27.55	6648.	0.28
	2	19.97	23.97	28.61	27.46	6626.	0.28
	3			48.80	51.20	9042.	
KL0009	1	22.62	15.20	32.59	29.60	7664.	0.40
	2	21.74	15.37	32.96	29.93	7751.	0.41
	3			51.16	48.84	9206.	
KL0010	1	21.94	18.32	30.80	28.94	6936.	0.38
	2	21.50	18.42	30.98	29.10	6976.	0.38
	3			49.98	50.02	8691.	
KL0011	1	18.13	8.27	37.90	35.70	8978.	0.36
	2	19.29	8.15	37.37	35.19	8851.	0.36
	3			50.91	49.09	9880.	
KL0012	1	19.51	23.60	30.97	25.92	8654.	0.33
	2	19.69	23.55	30.90	25.86	8635.	0.32
	3			52.42	47.58	11694.	
KL0013	1	17.05	19.46	33.17	30.32	7576.	0.31
	2	21.29	18.47	31.48	28.77	7189.	0.30
	3			50.70	49.30	9643.	
KL0014	1	22.41	13.17	34.86	29.56	8504.	0.31
	2	21.20	13.38	35.40	30.02	8637.	0.32
	3			53.12	46.88	9948.	
KL0016	1	19.23	16.51	33.79	30.47	9034.	0.48
	2	19.86	16.38	33.52	30.23	8963.	0.47
	3			51.27	48.73	11045.	
KL0017	1	20.02	13.47	34.98	31.52	8337.	0.51
	2	20.66	13.37	34.70	31.27	8270.	0.50
	3			51.56	48.44	9793.	

Table B1 (con.)

Sample no.	Basis*	Moisture (%)	Ash (%)	VM (%)	FC (%)	Heat value Btu/lb	Total sulfur (%)
KL0018	1	21.66	19.31	32.03	27.01	8374.	0.45
	2	21.08	19.45	32.27	27.21	8436.	0.46
	3			52.65	47.35	10637.	
KL0019	1	20.43	13.08	33.61	32.88	8276.	0.53
	2	19.90	13.16	33.84	33.10	8332.	0.54
	3			49.49	50.51	9673.	
KL0020	1	18.02	24.10	30.32	27.56	6886.	0.41
	2	18.72	23.89	30.06	27.33	6827.	0.40
	3			50.26	49.74	9375.	
GL01-01	1	24.38	5.74	36.20	33.68	8443.	0.37
	2	23.87	5.78	36.45	33.90	8500.	0.37
	3			51.37	48.63	9016.	
GL02-01	1	22.36	21.60	30.80	25.24	6443.	0.39
	2	23.11	21.39	30.51	24.99	6381.	0.39
	3			53.11	46.89	8456.	
GR01-02	1	24.27	10.98	33.82	30.93	7744.	0.33
	2	24.53	10.94	33.71	30.82	7717.	0.32
	3			51.37	48.63	8811.	
GR02-01	1	30.44	7.93	33.00	28.63	7346.	0.29
	2	28.24	8.18	34.04	29.54	7578.	0.30
	3			52.90	47.10	8050.	
GR03-01	1	25.62	16.03	32.94	25.41	7284.	0.29
	2	24.76	16.22	33.32	25.70	7368.	0.30
	3			55.18	44.82	8847.	
JL01-02	1	24.88	31.16	25.46	18.50	4664.	0.38
	2	23.49	31.74	25.93	18.84	4751.	0.39
	3			54.64	45.36	7101.	
JL02-01	1	22.46	1.64	47.57	28.34	7215.	0.45
	2	23.78	1.61	46.76	27.85	7092.	0.45
	3			62.55	37.45	7351.	
JL03-01	1	21.78	6.07	40.27	31.88	8060.	0.26
	2	21.33	6.11	40.50	32.06	8106.	0.26
	3			55.42	44.58	8639.	

Table B1 (con.)

Sample no.	Basis*	Moisture (%)	Ash (%)	VM (%)	FC (%)	Heat value Btu/lb	Total sulfur (%)
JL05-01	1	25.15	6.06	36.37	32.42	8079.	0.27
	2	24.70	6.10	36.59	32.61	8127.	0.27
	3			52.42	47.58	8659.	
JL05-02	1	28.65	9.38	33.70	28.27	7188.	0.32
	2	27.30	9.55	34.34	28.80	7324.	0.32
	3			53.65	46.35	8018.	
JL06-01	1	18.94	14.76	35.33	30.97	8633.	0.27
	2	17.75	14.97	35.85	31.43	8759.	0.27
	3			52.20	47.80	10309.	
JL07-01	1	25.99	10.09	35.06	28.86	7555.	0.33
	2	25.68	10.13	35.21	28.98	7587.	0.33
	3			54.09	45.91	8502.	
JL08-01	1	25.60	13.03	32.54	28.83	7377.	0.28
	2	24.43	13.24	33.05	29.28	7493.	0.29
	3			51.97	48.03	8615.	
JL09-01	1	24.58	30.89	26.15	18.38	7762.	0.32
	2	20.04	32.75	27.73	19.49	8230.	0.34
	3			55.60	44.40	11763.	
JL13-01	1	25.71	28.99	24.26	21.04	5197.	0.40
	2	23.20	29.97	25.08	21.75	5373.	0.42
	3			50.32	49.68	7635.	
JL13-02	1	28.67	23.07	26.12	22.14	5657.	0.36
	2	25.87	23.98	27.14	23.01	5879.	0.38
	3			51.75	48.25	7585.	
JL14-01	1	26.24	29.52	26.16	18.08	5417.	0.48
	2	ISS	ISS	ISS	ISS	ISS	ISS
	3			56.13	43.87	8028.	
JL15-01	1	26.61	16.62	30.43	26.34	6984.	0.33
	2	23.57	17.31	31.70	27.43	7273.	0.34
	3			52.17	47.83	8549.	
JL16-01	1	22.39	41.60	20.85	15.16	7391.	0.34
	2	20.93	42.38	21.24	15.44	7530.	0.35
	3			52.33	47.67	13636.	

Table B1 (con.)

Sample no.	Basis*	Moisture (%)	Ash (%)	VM (%)	FC (%)	Heat value Btu/lb	Total sulfur (%)
JL18-01	1	27.55	20.36	27.16	24.93	6181.	0.26
	2	23.70	21.45	28.60	26.25	6509.	0.27
	3			50.15	49.85	7968.	
JL19-01	1	24.32	22.64	30.01	23.03	6410.	0.29
	2	22.07	23.32	30.90	23.71	6601.	0.30
	3			54.61	45.39	8540.	
JL21-01	1	25.73	22.08	28.68	23.51	7497.	0.34
	2	23.92	22.62	29.38	24.08	7680.	0.35
	3			52.92	47.08	9907.	
JL22-01	1	26.17	16.86	28.76	28.21	6747.	0.30
	2	24.59	17.22	29.38	28.81	6892.	0.30
	3			48.94	51.06	8286.	
JL23-01	1	24.40	15.22	30.89	29.48	7404.	0.29
	2	23.65	15.37	31.20	29.78	7477.	0.29
	3			49.87	50.13	8896.	
JL25-01	1	27.45	13.25	32.70	26.60	6969.	0.40
	2	26.57	13.41	33.10	26.92	7053.	0.41
	3			54.07	45.93	8162.	
JL25-03	1	25.15	10.09	34.59	30.18	7906.	0.40
	2	25.19	10.08	34.57	30.16	7902.	0.40
	3			52.63	47.37	8896.	
JL26-01	1	25.56	29.83	36.80	7.81	5090.	0.36
	2	20.21	31.98	39.44	8.37	5455.	0.38
	3			81.21	18.79	7580.	
JL27-01	1	27.48	10.13	33.09	29.30	7500.	0.41
	2	25.32	10.44	34.07	30.17	7724.	0.42
	3			52.21	47.79	8445.	
JL29-01	1	27.93	10.13	32.89	29.05	7185.	0.35
	2	26.04	10.40	33.75	29.81	7373.	0.42
	3			52.27	47.73	8089.	
JL29-04	1	23.15	21.76	28.24	26.85	6536.	0.43
	2	23.69	21.60	28.05	26.66	6490.	0.43
	3			49.20	50.80	8597.	
JL30-01	1	27.18	22.86	27.95	22.01	7386.	0.29
	2	24.17	23.80	29.11	22.92	7692.	0.31
	3			53.80	46.20	9871.	

Table 81 (con.)

Sample no.	Basis*	Moisture (%)	Ash (%)	VM (%)	FC (%)	Heat value Btu/lb	Total sulfur (%)
JL31-01	1	23.91	27.09	27.12	21.87	5661.	0.30
	2	21.21	28.06	28.08	22.65	5862.	0.31
	3			52.70	47.30	8068.	
JL31-02	1	22.97	22.39	30.75	23.89	6661.	0.32
	2	22.82	22.44	30.81	23.93	6674.	0.32
	3			54.37	45.63	8842.	
JL32-01	1	28.06	11.20	32.35	28.40	7052.	0.34
	2	27.76	11.24	32.48	28.51	7081.	0.34
	3			52.34	47.66	8045.	
JL33-01	1	27.58	11.36	34.84	26.22	7473.	0.32
	2	24.96	11.77	36.10	27.17	7743.	0.33
	3			56.21	43.79	8543.	
JL34-01	1	24.66	7.47	35.21	32.66	8036.	0.37
	2	24.77	7.46	35.16	32.61	8024.	0.36
	3			51.30	48.70	8759.	
JL34-02	1	25.44	7.27	33.89	33.40	7941.	0.32
	2	25.46	7.27	33.88	33.39	7939.	0.32
	3			49.79	50.21	8634.	
JL36-01	1	24.43	14.19	33.16	28.22	7246.	0.37
	2	24.05	14.26	33.33	28.36	7282.	0.38
	3			52.89	47.11	8590.	
JL36-02	1	25.10	19.48	30.56	24.86	6482.	0.31
	2	22.77	20.09	31.51	25.63	6683.	0.32
	3			53.46	46.54	8253.	
JL37-01	1	24.28	7.24	35.84	32.63	8083.	0.27
	2	24.09	7.26	35.93	32.72	8103.	0.27
	3			51.81	48.19	8785.	
JL38-01	1	24.88	18.24	30.48	26.40	6742.	0.40
	2	24.29	18.38	30.72	26.61	6795.	0.40
	3			52.00	48.00	8438.	
JL39-01	1	30.57	25.60	24.42	19.41	5111.	0.45
	2	22.44	28.60	27.28	21.68	5709.	0.50
	3			52.89	47.11	7119.	
JL39-02	1	24.88	17.90	31.54	25.68	6760.	0.32
	2	22.43	18.48	32.57	26.52	6980.	0.33
	3			53.63	46.37	8420.	

Table B1 (con.)

Sample no.	Basis*	Moisture (%)	Ash (%)	VM (%)	FC (%)	Heat value Btu/lb	Total sulfur (%)
JL40-01	1	24.23	15.23	33.38	27.17	7228.	0.30
	2	22.95	15.48	33.94	27.62	7350.	0.30
	3			53.94	46.06	8685.	
JL41-01	1	25.62	16.23	32.15	26.00	7803.	0.31
	2	23.75	16.64	32.96	26.65	7999.	0.32
	3			53.97	46.03	9503.	
JL42-01	1	19.24	10.55	37.60	32.60	8256.	0.28
	2	21.09	10.31	36.74	31.86	8067.	0.28
	3			52.82	47.18	9344.	
JL43-01	1	24.00	13.41	33.28	29.32	7270.	0.33
	2	24.26	13.36	33.16	29.21	7245.	0.33
	3			52.10	47.90	8531.	
JL45-01	1	24.69	10.19	37.25	27.88	7954.	0.41
	2	24.49	10.21	37.35	27.95	7975.	0.41
	3			56.47	43.53	8962.	
JL45-03	1	23.27	21.91	31.67	23.14	6414.	0.44
	2	22.66	22.09	31.93	23.33	6465.	0.44
	3			55.97	44.03	8456.	
JL46-01	1	24.13	21.14	31.35	23.38	6463.	0.37
	2	24.07	21.16	31.37	23.40	6468.	0.37
	3			55.51	44.49	8425.	
JL47-01	1	24.80	5.37	39.37	30.46	8216.	0.28
	2	24.84	5.37	39.34	30.45	8212.	0.28
	3			56.01	43.99	8735.	
JL48-01	1	25.06	13.76	35.20	25.98	7727.	0.38
	2	24.61	13.84	35.41	26.14	7774.	0.38
	3			56.51	43.49	9109.	
JL49-01	1	29.87	17.51	28.87	23.75	6032.	0.39
	2	ISS	ISS	ISS	ISS	ISS	ISS
	3			53.27	46.73	7474.	
JL50-01	1	27.55	18.05	31.16	23.24	6231.	0.39
	2	ISS	ISS	ISS	ISS	ISS	ISS
	3			55.77	46.73	7474.	
JL50-04	1	30.90	12.66	31.57	24.87	6531.	0.43
	2	28.78	13.05	32.54	25.64	6731.	0.44
	3			54.87	45.13	7591.	

Table B1 (con.)

Sample no.	Basis*	Moisture (%)	Ash (%)	VM (%)	FC (%)	Heat value Btu/lb	Total sulfur (%)
JL51-01	1	24.50	17.79	33.42	24.29	6649.	0.47
	2	24.72	17.74	33.33	24.22	6629.	0.47
	3			56.52	43.48-	8271.	
JL52-01	1	27.42	9.56	36.64	26.38	7468.	0.30
	2	25.82	9.77	37.44	26.96	7633.	0.31
	3			57.46	42.54	8349.	
JL54-01	1	22.19	23.53	27.96	26.32	8320.	0.59
	2	19.94	24.21	28.77	27.08	8561.	0.60
	3			49.23	50.77	11235.	
JL56-01	1	23.51	19.12	30.30	27.08	6768.	0.49
	2	22.12	19.46	30.85	27.57	6891.	0.50
	3			51.12	48.88	8576.	
JL57-01	1	25.86	8.06	34.40	31.68	7917.	0.36
	2	25.34	8.12	34.64	31.90	7972.	0.36
	3			51.43	48.57	8691.	
JL58-01	1	25.44	9.24	33.61	31.71	7728.	0.36
	2	25.28	9.26	33.68	31.78	7744.	0.36
	3			50.72	49.28	8605.	
JL59-01	1	25.29	12.09	32.88	29.73	7478.	0.59
	2	23.82	12.33	33.53	30.32	7625.	0.60
	3			51.51	48.49	8632.	

*1 - As received
2 - Equilibrium bed moisture
3 - VM, FC are dry mineral matter free, Btu/lb is moist mineral matter free.
ISS indicates insufficient sample to do analysis.

Table B2. Detailed listing of coal petrologic results for samples from the southern Kenai Peninsula.

A. Sterling Formation, Cook Inlet

Sample no.	Ulminite/ vitrinite	Pseudo- vitrinite	Phlobaphi- nite	Pseudo- phloba- phinite	Pori- gelinite	Spori- nite	Resi- nite	Cuti- nite	Algi- nite	Exudati- nite	Suberi- nite	Lipto- detri- nite	Macri- nite	Fusi- nite	Semi- fusi- nite	Scleroti- nite	Inerto- detrinite
86JL54-01	83.8	0.0	1.4	0.8	0.6	1.2	3.6	1.2	0.0	0.0	0.6	3.4	0.0	1.0	1.8	0.0	0.6
86JL57-01	80.4	0.0	3.2	1.2	1.2	2.2	2.2	1.0	0.0	0.2	1.2	3.4	0.2	0.0	1.4	1.2	1.0
86JL59-01	85.8	0.0	1.8	2.0	1.6	1.6	1.0	0.8	0.0	0.0	0.4	2.4	0.0	0.0	1.6	0.6	0.4
86JL34-01	81.8	0.0	2.0	1.8	1.8	1.2	1.8	1.2	0.0	0.0	2.0	3.2	0.0	0.0	1.2	1.0	1.0
86JL34-02	82.4	0.0	3.4	3.2	3.4	1.4	1.2	0.2	0.0	0.0	1.4	2.4	0.0	0.0	0.4	0.6	0.0
86JL38-01	86.6	0.0	1.6	1.0	0.6	1.4	1.8	0.2	0.0	0.0	0.6	2.8	0.0	0.0	2.2	0.4	0.8
86JL41-01	81.8	0.0	1.6	2.2	0.2	2.8	2.0	0.6	0.0	0.0	1.4	1.8	0.4	1.2	2.2	0.4	1.4
86JL42-01	83.2	0.0	0.6	0.8	0.6	2.2	2.0	0.4	0.0	0.0	1.2	5.2	0.4	0.2	2.4	0.0	0.8
86JL45-01	79.4	0.0	1.4	0.6	0.6	1.0	2.2	0.4	0.0	0.0	1.4	2.4	0.2	7.2	3.4	1.0	3.8
86JL47-01	85.8	0.0	1.0	0.6	0.6	1.8	2.0	0.8	0.0	0.0	1.0	3.6	0.0	0.4	1.0	0.4	1.0
86JL48-01	82.0	0.0	2.0	1.0	0.2	1.2	1.4	0.6	0.0	0.0	1.4	2.8	0.6	0.8	3.2	1.2	1.6
86JL49-01	84.6	0.0	2.2	0.8	1.0	0.8	1.6	0.6	0.0	0.0	1.6	3.4	0.4	0.0	1.6	0.6	0.8
86GR03-01	86.2	0.0	1.4	0.4	1.0	0.8	2.0	0.4	0.0	0.0	0.4	2.6	0.0	0.4	2.6	0.4	1.4
86JL02-01	89.6	0.0	0.4	0.0	0.2	1.8	1.4	1.0	0.0	0.0	1.2	2.4	0.0	0.0	1.4	0.2	0.4
86JL03-01	88.2	0.0	1.2	0.6	0.6	1.0	1.2	0.2	0.0	0.0	2.6	2.8	0.0	0.0	0.6	0.6	0.4
86JL05-01	84.2	0.2	1.4	0.2	0.8	1.8	1.6	0.2	0.0	0.0	1.8	3.6	0.0	0.2	2.0	1.2	0.8
86JL06-01	86.2	0.0	0.6	0.8	0.4	2.0	1.0	0.0	0.0	0.0	0.2	0.4	0.6	0.6	5.0	0.4	1.8
86JL07-01	80.8	0.0	1.4	1.6	0.7	4.2	3.0	0.0	0.0	0.0	1.4	3.8	0.4	0.2	1.6	0.2	0.8
86JL08-01	83.4	0.0	1.2	0.2	0.2	2.6	2.0	0.0	0.0	0.0	0.6	3.0	0.4	0.6	3.4	0.2	2.2
86JL09-01	74.4	0.0	0.6	1.6	0.4	6.0	3.4	1.8	0.0	0.0	0.6	7.8	0.0	0.0	2.0	0.4	1.0
86JL14-01	70.8	0.0	0.0	1.2	0.6	6.0	5.2	0.6	0.2	0.0	0.8	6.2	0.0	1.2	3.8	0.8	2.6
86JL15-01	57.4	0.0	7.2	0.4	1.0	4.0	3.6	0.4	0.0	0.0	2.6	4.0	2.4	6.4	7.4	1.2	3.0
86JL16-01	86.0	0.0	1.0	0.4	1.2	0.8	2.0	1.0	0.0	0.0	1.4	3.4	0.0	0.2	2.0	0.0	0.6
86JL18-01	83.2	0.0	0.2	0.4	0.4	2.8	3.4	0.8	0.0	0.0	0.4	4.2	0.6	0.6	2.0	0.2	0.8
86JL19-01	72.8	0.0	1.6	0.2	1.4	3.8	3.8	0.8	0.0	0.0	2.6	6.0	0.4	1.0	2.4	1.0	2.2
86JL21-01	82.2	0.2	1.0	0.4	0.0	2.0	2.4	0.8	0.0	0.2	0.8	3.6	0.0	1.2	3.2	0.6	1.4
86JL22-01	81.0	0.0	0.8	0.2	0.4	3.8	2.8	0.2	0.4	0.0	1.4	4.2	0.2	0.8	2.0	0.2	1.6
86JL23-01	82.4	0.0	1.0	0.4	0.6	2.0	2.6	1.2	0.0	0.0	2.4	3.2	0.6	0.4	1.8	1.0	0.4
86JL25-01	86.4	0.0	1.4	0.8	0.8	0.8	2.4	0.2	0.0	0.0	1.2	2.2	0.2	0.4	1.4	0.8	1.0
86JL25-03	80.2	0.0	2.4	2.8	2.0	3.2	1.8	0.0	0.0	0.0	1.0	1.4	0.0	1.0	2.0	0.4	1.8
86JL26-01	85.0	0.0	2.0	0.8	1.0	1.6	1.6	0.4	0.0	0.0	2.2	2.6	0.2	0.2	1.0	0.4	1.0
86JL27-01	78.0	0.0	1.4	1.8	1.0	2.2	2.6	0.6	0.0	0.0	1.6	4.4	0.4	2.0	1.0	0.2	2.8
86JL29-01	81.8	0.0	1.8	0.8	2.0	1.4	1.6	0.6	0.0	0.0	1.6	2.6	0.8	0.4	3.0	0.4	1.2
86JL30-01	79.4	0.0	1.4	1.8	0.0	2.8	3.2	0.8	0.0	0.2	0.8	5.2	0.4	0.8	1.2	0.4	1.6
86JL31-01	83.4	0.0	2.2	1.4	1.4	0.8	1.4	0.4	0.0	0.0	3.0	2.2	0.4	0.4	1.6	0.2	1.2
86JL33-01	89.8	0.0	2.6	0.4	0.8	1.2	0.4	0.4	0.0	0.0	0.2	2.0	0.2	0.0	1.2	0.4	0.4
86JL51-01	76.2	0.0	2.4	0.4	0.8	3.2	4.2	1.6	0.0	0.0	2.0	3.2	0.0	0.2	3.0	1.6	1.2
86JL52-01	83.4	0.0	3.8	1.2	3.2	1.2	1.2	0.0	0.0	0.0	1.0	2.4	0.0	0.2	0.8	1.2	0.4

Table B2 (con.)

B. Sterling Formation, Kachemak Bay

Sample no.	Ulminite/ vitrinite	Pseudo-vitrinite	Phlobaphi-nite	Pseudo-phloba-phinite	Pori-gelinite	Spori-nite	Resi-nite	Cuti-nite	Algi-nite	Exsudati-nite	Suberi-nite	Lipto-detri-nite	Macri-nite	Fusi-nite	Semi-fusi-nite	Scleroti-nite	Inerto-detrinite
86SM12-1	74.2	0.0	4.8	1.4	2.6	1.4	2.8	1.4	0.0	0.0	3.8	4.8	0.0	0.2	1.0	0.6	1.0
86SM11-5	84.8	0.0	2.6	1.2	1.8	0.8	2.2	0.6	0.0	0.0	1.2	3.2	0.0	0.0	1.0	0.0	0.6
86SM11-2	76.2	0.0	1.6	0.4	1.2	3.4	2.4	1.0	0.0	0.0	2.4	5.0	0.0	0.6	2.4	1.2	2.2
86SM11-1	87.6	0.0	1.6	0.8	0.4	1.6	2.0	0.0	0.0	0.0	0.6	1.0	0.2	1.2	1.4	0.4	1.2
86SM10-9	83.8	0.0	2.8	1.4	1.4	1.2	1.6	0.2	0.0	0.0	1.4	2.2	0.0	0.8	1.6	0.4	1.2
86SM10-7	88.2	0.0	2.0	1.2	1.2	1.0	1.4	0.2	0.0	0.0	0.6	2.2	0.4	0.0	0.4	0.8	0.4
86SM10-5	82.0	0.0	2.6	0.2	0.8	2.2	2.0	0.2	0.0	0.0	0.8	2.4	0.0	0.6	4.2	1.0	1.0
86SM10-3	76.4	0.0	2.8	0.6	0.8	2.0	1.4	0.8	0.0	0.0	3.0	2.6	0.4	0.6	5.4	1.0	2.2
86SM10-2	84.8	0.0	0.4	0.8	0.2	2.6	2.0	1.0	0.0	0.0	0.4	3.2	0.2	0.2	3.0	0.6	0.6
86SM10-1	79.2	0.0	1.8	1.0	0.8	1.6	2.8	0.4	0.0	0.0	3.4	3.0	0.2	0.8	3.2	0.0	1.8
86SM9-13	80.6	0.0	2.4	0.4	0.4	1.6	4.4	1.0	0.0	0.0	1.4	4.8	0.0	0.0	1.6	0.6	0.8
86SM9-11	82.6	0.0	1.0	0.0	0.2	1.4	2.4	0.4	0.0	0.0	0.6	2.6	0.0	1.2	4.8	0.6	2.2
86SM9-10	78.2	0.0	3.2	2.0	2.4	1.6	1.4	0.2	0.0	0.0	3.4	3.2	0.0	0.0	1.8	1.2	1.4
86SM9-09	86.8	0.0	1.2	1.0	0.4	1.2	1.0	0.2	0.0	0.0	2.2	2.2	0.0	0.2	2.0	0.8	0.8
86SM9-08	81.8	0.0	1.8	1.6	1.0	2.0	2.0	0.2	0.0	0.0	1.0	3.0	0.0	0.8	2.4	1.2	1.2
86SM9-07	80.6	0.0	0.8	2.4	0.2	1.2	3.0	1.4	0.0	0.0	1.8	3.2	0.0	0.8	2.6	1.0	1.0
86SM9-05	85.4	0.0	1.8	0.8	1.4	1.0	1.6	1.0	0.0	0.0	1.8	2.2	0.2	0.2	1.0	0.6	1.0
86SM9-03	79.8	0.0	3.0	1.2	2.0	1.0	1.4	0.2	0.0	0.0	3.4	3.6	0.0	0.8	2.2	0.6	0.8
86SM9-02	82.6	0.0	2.6	0.6	1.0	1.8	2.0	0.6	0.0	0.0	3.0	3.2	0.0	0.0	1.4	0.4	0.8
86SM9-01	84.4	0.0	1.2	0.6	0.2	2.4	2.2	0.4	0.0	0.0	1.8	2.4	0.0	0.6	2.4	0.8	0.6
86SM7-13	83.4	0.0	0.6	1.0	0.4	1.4	2.6	0.6	0.0	0.0	1.4	4.0	0.0	0.4	2.4	0.8	1.0
84SM7-11	78.8	0.0	2.6	1.2	1.2	2.4	2.2	0.0	0.0	0.0	2.6	3.6	0.4	1.2	1.2	0.8	1.8
86SM7-10	78.4	0.0	0.4	1.8	0.8	2.4	3.8	0.6	0.0	0.0	0.8	5.6	0.0	0.8	2.8	1.0	0.8
86SM7-09	86.2	0.0	1.4	0.4	1.2	1.8	0.6	0.2	0.0	0.0	2.6	2.4	0.0	0.0	1.4	1.4	0.4
86SM7-06	83.2	0.0	2.0	0.4	0.6	1.6	2.6	0.4	0.0	0.0	0.4	2.6	0.0	1.4	3.0	0.8	2.0
86SM7-04	78.8	0.0	3.2	1.4	1.4	1.0	2.0	0.6	0.0	0.0	4.3	3.2	0.2	0.2	2.4	0.6	1.0
86SM7-03	77.6	0.2	2.2	1.2	2.0	1.8	2.0	1.8	0.0	0.0	2.8	3.8	0.0	0.6	1.6	0.4	2.0
86SM7-01	78.2	0.0	2.2	0.2	0.4	2.6	3.2	1.0	0.0	0.0	1.0	7.8	0.4	1.6	4.2	0.4	1.6
86SM6-12	84.6	0.0	1.0	0.6	0.6	1.8	3.0	0.2	0.0	0.0	1.0	4.4	0.0	0.8	1.0	0.8	0.2
86SM6-11	89.4	0.0	1.4	0.0	0.5	1.0	1.2	0.2	0.0	0.0	1.0	3.0	0.0	0.2	0.8	0.4	0.8
86SM6-09	83.8	0.0	1.0	0.4	1.0	1.4	3.4	0.8	0.0	0.4	0.4	2.4	0.4	1.0	1.8	0.8	1.0
86SM6-07	82.2	0.0	1.4	0.8	1.4	0.8	1.4	0.8	0.0	0.0	1.6	2.0	0.2	1.4	3.4	1.0	1.4

Table B2 (con.)

C. Beluga Formation

Sample no.	Ulminite/ vitrinite	Pseudo-vitrinite	Phlobaphinite	Pseudo-phlobaphinite	Porigelinite	Sporinite	Resinite	Cutinite	Alginite	Exudatinite	Suberinite	Liptodetrinite	Macrinite	Fusinite	Semi-fusinite	Sclerotinite	Inertodetrinite
86SM6-05	82.0	0.0	0.8	2.4	1.0	1.4	1.6	0.0	0.0	0.0	1.0	0.6	0.8	2.6	2.4	0.6	2.8
86SM6-03	85.6	0.0	1.0	0.4	0.6	1.6	2.8	0.4	0.0	0.2	1.2	2.2	0.0	0.4	2.8	0.4	0.6
86SM6-01	80.8	0.0	1.6	0.0	0.4	2.2	2.6	0.8	0.0	0.0	1.6	2.0	0.2	1.2	5.0	0.0	1.6
86SM5-08	78.0	0.0	1.2	0.6	0.0	6.0	4.0	1.6	0.0	0.0	1.2	4.8	0.0	0.0	1.6	0.6	0.4
86SM5-05	80.0	0.0	2.6	1.0	1.6	2.0	3.2	0.8	0.0	0.0	1.8	5.0	0.0	0.0	1.0	0.4	0.6
86SM4-05	83.2	0.0	1.4	0.0	0.2	1.0	2.6	0.4	0.0	0.0	3.8	4.2	0.2	0.4	1.6	0.0	1.0
86SM4-04	82.8	0.0	2.4	0.4	0.4	0.4	1.4	1.0	0.0	0.0	1.0	2.6	0.0	1.4	3.6	0.6	2.0
86SM4-03	78.4	0.0	1.2	1.0	0.8	1.8	1.4	0.0	0.0	0.0	0.6	3.8	0.2	0.8	5.6	1.4	3.0
86SM4-02	86.2	0.0	1.4	1.0	1.4	1.2	1.6	1.0	0.0	0.0	1.8	2.2	0.0	0.4	1.0	0.0	0.8
86SM4-01	79.4	0.6	1.0	0.6	2.2	2.6	2.6	1.0	0.0	0.0	1.2	4.0	0.2	1.0	1.8	0.8	1.0
86SM3-05	86.0	0.0	1.0	0.0	0.4	1.4	3.2	0.2	0.0	0.0	0.4	3.8	0.0	1.0	1.4	0.2	1.0
86SM3-02	85.0	0.0	0.6	1.0	0.4	3.4	2.2	0.8	0.0	0.2	0.4	3.6	0.0	0.0	2.0	0.2	0.2
86SM3-01	80.2	0.0	2.8	2.4	1.0	1.0	2.2	1.4	0.0	0.0	3.8	3.8	0.2	0.2	0.6	0.0	0.4
86SM2-03	80.8	0.0	1.8	0.8	0.6	2.2	4.4	0.4	0.0	0.0	2.6	3.4	0.0	0.4	1.4	0.8	0.4
86SM2-01	86.4	0.0	1.2	2.2	0.4	1.4	2.0	0.6	0.0	0.0	0.8	2.4	0.0	0.0	1.2	0.8	0.6
86SM1-03	79.0	0.4	2.4	2.0	1.2	1.8	3.8	0.6	0.0	0.0	0.6	5.4	0.0	0.0	0.8	1.6	0.4
86SM1-01	81.2	0.0	2.0	2.0	0.0	2.6	6.2	0.0	0.0	0.0	1.6	1.6	0.2	0.0	1.4	0.6	0.6
86SM15-1	84.0	0.0	2.4	1.2	1.0	2.0	2.0	0.6	0.0	0.2	0.4	1.2	0.4	0.0	2.4	1.2	1.0
KL0002	78.6	0.0	1.2	0.8	1.0	3.0	3.6	0.8	0.0	0.2	1.8	5.4	0.0	0.4	2.4	0.6	0.2
KL0007	80.2	0.0	1.2	0.6	1.0	3.2	4.0	0.6	0.0	0.0	0.8	4.0	0.0	0.4	2.0	1.0	1.0
KL0008	84.6	0.0	1.0	0.6	0.6	2.2	5.0	0.6	0.0	0.0	0.4	3.0	0.0	0.0	1.0	0.8	0.2
KL0010	83.2	0.2	1.6	1.0	1.0	1.8	3.4	0.6	0.0	0.0	0.8	5.8	0.0	0.0	0.2	0.2	0.2
KL0012	80.6	0.0	2.0	2.0	0.0	2.6	6.2	0.6	0.0	0.0	1.6	1.6	0.2	0.0	1.4	0.6	0.6
KL0014	86.8	0.0	0.8	0.4	0.8	1.6	3.0	1.2	0.0	0.0	0.6	2.6	0.0	0.2	1.2	0.6	0.2
KL0016	82.6	0.0	1.2	0.8	0.8	3.2	3.0	0.8	0.0	0.4	0.2	4.6	0.0	0.0	0.8	0.8	0.8
KL0017	78.4	0.0	1.6	1.0	1.4	3.4	6.0	0.6	0.0	0.4	0.4	5.4	0.0	0.0	0.8	0.2	0.2
KL0018	83.4	0.0	2.0	0.2	0.0	2.4	4.4	1.2	0.0	0.0	0.6	4.6	0.0	0.0	0.8	0.2	0.2
86SM14-04	83.8	0.0	1.8	1.2	1.0	2.2	3.0	0.6	0.0	0.0	0.4	3.0	0.0	0.4	1.8	0.6	0.2
86SM14-01	75.2	0.0	0.8	1.0	0.4	5.8	5.0	1.6	0.0	0.4	1.0	6.0	0.0	0.0	2.0	0.4	0.4
86SM13-01	92.6	0.0	0.2	1.0	1.2	1.0	2.0	0.0	0.0	0.0	0.0	1.4	0.0	0.0	0.4	0.2	0.0

Table B3. Detailed listing of microlithotype contents for samples from the southern Kenai Peninsula.

A. Sterling Formation, Cook Inlet

Sample no.	*	Vitrite	Liptite	Inertite	Durite	Clarite	Vitriner-tite	Duro-clarite	Claro-durite	Vitrinerto-liptite	Carbargi-lite	Carbo-pyrite	Carbanker-ite	Carbo-silicite	Total carbominera-lites
86JL54-01	A	76.7	0.0	0.0	0.0	17.7	3.9	1.7	0.0	0.0	6.6	1.0	0.8	0.0	8.4
	B	70.2	0.0	0.0	0.0	16.2	3.6	1.6	0.0	0.0					
86JL57-01	A	76.1	0.0	0.0	0.0	15.1	5.8	3.0	0.0	0.0	5.8	0.6	0.6	0.0	7.0
	B	70.8	0.0	0.0	0.0	14.0	5.4	2.8	0.0	0.0					
86JL59-01	A	79.7	0.0	0.2	0.0	16.9	3.0	0.2	0.0	0.0	7.8	5.2	0.4	0.0	13.4
	B	69.0	0.0	0.2	0.0	14.6	2.6	0.2	0.0	0.0					
86JL34-01	A	71.5	0.0	0.0	0.0	24.9	1.9	1.7	0.0	0.0	4.2	0.0	1.0	0.0	5.2
	B	67.8	0.0	0.0	0.0	23.6	1.8	1.6	0.0	0.0					
86JL34-02	A	79.2	0.0	0.0	0.0	16.3	3.3	1.2	0.0	0.0	1.6	0.0	1.2	0.2	3.0
	B	76.8	0.0	0.0	0.0	15.8	3.2	1.2	0.0	0.0					
86JL38-01	A	71.2	0.0	0.0	0.0	16.5	8.9	3.4	0.0	0.0	10.2	0.0	1.6	0.8	12.6
	B	62.2	0.0	0.0	0.0	14.4	7.8	3.0	0.0	0.0					
86JL41-01	A	70.4	0.0	0.2	0.0	14.6	9.5	5.3	0.0	0.0	7.4	0.0	5.4	0.6	13.4
	B	61.0	0.0	0.2	0.0	12.6	8.2	4.6	0.0	0.0					
86JL42-01	A	67.0	0.0	0.2	0.0	14.0	13.8	5.0	0.0	0.0	6.6	0.2	1.4	0.2	8.4
	B	61.4	0.0	0.2	0.0	12.8	12.6	4.6	0.0	0.0					
86JL45-01	A	51.0	0.0	0.0	0.0	16.1	21.2	11.6	0.0	0.0	5.8	0.2	0.6	0.0	6.6
	B	47.6	0.0	0.0	0.0	15.0	19.8	10.8	0.0	0.0					
86JL47-01	A	78.3	0.0	0.2	0.0	16.3	3.3	1.9	0.0	0.0	2.6	0.2	0.4	0.0	3.2
	B	75.8	0.0	0.2	0.0	15.8	3.2	1.8	0.0	0.0					
86JL48-01	A	65.7	0.0	0.2	0.0	17.9	12.5	3.7	0.0	0.0	12.4	0.0	1.4	0.0	13.8
	B	56.6	0.0	0.2	0.0	15.4	10.8	3.2	0.0	0.0					
86JL49-01	A	76.1	0.0	0.0	0.0	18.2	4.1	1.7	0.0	0.0	10.2	0.6	4.6	1.0	16.4
	B	63.6	0.0	0.0	0.0	15.2	3.4	1.4	0.0	0.0					
86CR03-01	A	85.0	0.0	0.0	0.0	10.2	4.1	0.7	0.0	0.0	15.0	0.8	1.4	0.2	17.4
	B	70.2	0.0	0.0	0.0	8.4	3.4	0.6	0.0	0.0					
86JL02-01	A	95.6	0.0	0.0	0.0	2.5	1.7	0.2	0.0	0.0	3.4	0.2	1.2	0.2	5.0
	B	90.8	0.0	0.0	0.0	2.4	1.6	0.2	0.0	0.0					
86JL03-01	A	82.9	0.2	0.2	0.0	13.4	2.2	1.1	0.0	0.0	6.2	0.0	1.0	0.4	7.6
	B	76.6	0.2	0.2	0.0	12.4	2.0	1.0	0.0	0.0					
86JL05-01	A	76.1	0.0	0.0	0.0	19.8	6.0	3.0	0.0	0.0	5.4	0.4	0.6	0.6	7.0
	B	70.8	0.0	0.0	0.0	13.8	5.6	2.8	0.0	0.0					
86JL06-01	A	82.4	0.0	0.2	0.0	9.5	5.9	2.0	0.0	0.0	6.2	0.0	3.0	0.0	9.2
	B	74.8	0.0	0.2	0.0	8.6	5.4	1.8	0.0	0.0					
86JL07-01	A	66.3	0.2	0.0	0.0	22.0	5.4	5.6	0.0	0.0	3.4	0.0	4.0	0.0	7.4
	B	61.4	0.2	0.0	0.0	20.4	5.0	5.2	0.0	0.0					
86JL08-01	A	67.3	0.0	0.4	0.0	13.6	12.9	5.8	0.0	0.0	6.6	0.0	3.0	0.4	10.0
	B	60.6	0.0	0.4	0.0	12.2	11.6	5.2	0.0	0.0					

*A = Content with carbominerallites factored out; and B = Content with carbominerallites factored in.

Table B3. (con.)

Sample no.	*	Vitrite	Liptite	Inertite	Durite	Clarite	Vitriner-tite	Duro-clarite	Claro-durite	Vitrinerto-liptite	Carbargi-lite	Carbo-pyrite	Carbanker-ite	Carbo-silicite	Total carbominera-lites
86JL09-01	A	68.5	0.0	0.3	0.0	24.1	3.6	3.3	0.0	0.0					
	B	53.4	0.0	0.2	0.0	18.8	2.8	2.6	0.0	0.0	18.6	0.0	2.6	0.8	22.0
86JL14-01	A	27.2	0.0	0.0	0.0	48.8	6.6	17.5	0.0	0.0					
	B	17.4	0.0	0.0	0.0	31.2	4.2	11.2	0.0	0.0	28.4	1.0	4.8	1.8	36.0
86JL15-01	A	32.1	0.0	1.2	0.0	14.4	31.4	20.8	0.2						
	B	27.2	0.0	1.0	0.0	12.2	26.6	17.6	0.2	0.0	10.4	2.8	1.4	0.6	15.2
86JL16-01	A	71.8	0.0	0.0	0.0	18.8	5.0	4.4	0.0	0.0					
	B	49.0	0.0	0.0	0.0	12.8	3.4	3.0	0.0	0.0	26.6	0.6	4.4	0.2	31.8
86JL18-01	A	68.4	0.0	0.5	0.0	22.0	5.8	3.2	0.0	0.0					
	B	59.0	0.0	0.4	0.0	19.0	5.0	2.8	0.0	0.0	10.4	0.2	2.6	0.6	13.8
86JL19-01	A	52.5	0.0	0.2	0.0	32.8	8.0	6.5	0.0	0.0					
	B	43.6	0.0	0.2	0.0	27.2	6.6	5.4	0.0	0.0	14.8	0.4	1.2	0.6	17.0
86JL21-01	A	70.6	0.0	0.5	0.0	16.0	6.1	6.9	0.0	0.0					
	B	55.6	0.0	0.4	0.0	12.6	4.8	5.4	0.0	0.0	17.8	0.0	3.2	0.2	21.2
86JL22-01	A	76.0	0.0	0.0	0.0	13.3	8.1	2.6	0.0	0.0					
	B	63.8	0.0	0.0	0.0	11.2	6.8	2.2	0.0	0.0	10.6	0.2	4.8	0.4	16.0
86JL23-01	A	68.0	0.0	0.2	0.2	20.2	8.8	2.6	0.0	0.0					
	B	58.6	0.0	0.2	0.2	17.4	7.6	2.2	0.0	0.0	8.0	0.2	5.4	0.2	13.8
86JL25-01	A	73.9	0.0	0.2	0.0	15.9	8.3	1.7	0.0	0.0					
	B	62.4	0.0	0.2	0.0	13.4	7.0	1.4	0.0	0.0	8.4	4.2	2.6	0.4	15.6
86JL25-03	A	80.8	0.0	0.0	0.0	8.2	7.1	3.8	0.0	0.2					
	B	73.2	0.0	0.0	0.0	7.4	6.4	3.4	0.0	0.2	6.4	0.8	2.0	0.2	9.4
86JL26-01	A	77.6	0.6	0.0	0.0	13.0	6.4	2.1	0.0	0.0					
	B	51.2	0.4	0.0	0.0	8.6	4.2	1.4	0.0	0.0	13.0	1.4	18.2	1.4	34.0
86JL27-01	A	62.8	0.0	0.8	0.0	18.4	12.3	5.6	0.0	0.0					
	B	60.0	0.0	0.8	0.0	17.6	11.8	5.4	0.0	0.0	3.0	0.0	1.0	0.4	4.4
86JL29-01	A	66.4	0.2	0.2	0.0	16.3	10.7	6.1	0.0	0.0					
	B	63.4	0.2	0.2	0.0	15.6	10.2	5.8	0.0	0.0	2.6	0.0	2.0	0.0	4.6
85JL30-01	A	69.6	0.0	0.3	0.3	20.1	5.7	4.1	0.0	0.0					
	B	54.0	0.0	0.2	0.2	15.6	4.4	3.2	0.0	0.0	10.6	0.0	10.2	1.6	22.4
85JL31-01	A	81.7	0.0	0.0	0.0	14.7	3.0	0.5	0.0	0.0					
	B	64.4	0.0	0.0	0.0	11.6	2.4	0.4	0.0	0.0	15.2	0.8	4.0	1.2	21.2
86JL33-01	A	81.1	0.0	0.0	0.0	14.5	3.0	1.3	0.0	0.0					
	B	74.8	0.0	0.0	0.0	13.4	2.8	1.2	0.0	0.0	5.2	0.8	1.8	0.0	7.8
86JL51-01	A	57.6	0.0	1.0	0.0	28.2	6.7	6.5	0.0	0.0					
	B	47.8	0.0	0.8	0.0	23.4	5.6	5.4	0.0	0.0	11.0	1.0	4.8	0.2	17.0
86JL52-01	A	77.4	0.0	0.0	0.0	12.4	8.2	2.1	0.0	0.0					
	B	73.8	0.0	0.0	0.0	11.8	7.8	2.0	0.0	0.0	3.6	0.0	1.0	0.0	4.6

Table B3. (con.)

B. Sterling Formation, Kachemak Bay

Sample no.	n	Vitrite	Liptite	Inertite	Durite	Clarite	Vitriner-tite	Duro-clarite	Claro-durite	Vitrinerto-liptite	Carbargi-lite	Carbo-pyrite	Carbanker-ite	Carbo-silicite	Total carbominera-lites
86SM12-1	A	78.3	0.2	0.0	0.0	16.0	4.2	1.2	0.0	0.0	16.8	0.2	1.8	0.0	18.8
	B	63.6	0.2	0.0	0.0	13.0	3.4	1.0	0.0	0.0					
86SM11-5	A	74.2	0.0	0.0	0.0	17.9	5.0	3.0	0.0	0.0	19.2	0.0	0.2	0.0	19.4
	B	59.8	0.0	0.0	0.0	14.4	4.0	2.4	0.0	0.0					
86SM11-2	A	61.2	0.5	0.5	0.0	23.6	8.7	5.6	0.0	0.0	15.8	0.2	1.4	0.2	17.6
	B	50.4	0.4	0.4	0.0	19.4	7.2	4.6	0.0	0.0					
86SM11-1	A	71.8	0.0	0.4	0.0	10.6	10.0	2.4	0.0	0.0	5.2	0.0	1.8	0.8	7.8
	B	70.6	0.0	0.4	0.0	9.8	9.2	2.2	0.0	0.0					
86SM10-9	A	77.9	0.5	0.2	0.0	13.2	7.1	1.2	0.0	0.0	10.4	0.4	3.4	0.8	15.0
	B	66.2	0.4	0.2	0.0	11.2	6.0	1.0	0.0	0.0					
86SM10-7	A	89.9	0.0	0.0	0.0	6.0	3.7	0.5	0.0	0.0	7.2	0.2	5.4	0.2	13.0
	B	78.2	0.0	0.0	0.0	5.2	3.2	0.4	0.0	0.0					
86SM10-5	A	79.3	0.0	0.6	0.0	11.1	7.7	1.4	0.0	0.0	11.6	0.2	17.4	0.4	29.6
	B	55.8	0.0	0.4	0.0	7.8	5.4	1.0	0.0	0.0					
86SM10-3	A	69.3	0.0	0.0	0.0	14.2	13.0	3.5	0.0	0.0	10.2	0.0	3.4	0.4	14.0
	B	59.6	0.0	0.0	0.0	12.2	11.2	3.0	0.0	0.0					
86SM10-2	A	83.8	0.0	0.2	0.0	12.4	1.6	1.9	0.0	0.0	11.2	0.0	3.4	0.2	14.8
	B	71.4	0.0	0.2	0.0	10.6	1.4	1.6	0.0	0.0					
86SM10-1	A	76.4	0.0	0.0	0.0	13.8	6.5	3.3	0.0	0.0	3.2	0.2	0.8	0.0	4.2
	B	73.2	0.0	0.0	0.0	13.2	6.2	3.2	0.0	0.0					
86SM9-13	A	80.8	0.0	0.0	0.0	10.8	5.8	2.6	0.0	0.0	15.6	0.0	1.0	0.0	16.6
	B	67.4	0.0	0.0	0.0	9.0	4.8	2.2	0.0	0.0					
86SM9-11	A	57.3	0.2	0.2	0.0	19.4	15.6	7.2	0.0	0.0	5.4	0.0	0.0	0.0	5.4
	B	54.2	0.2	0.2	0.0	18.4	14.8	6.8	0.0	0.0					
86SM9-10	A	67.5	0.0	0.0	0.0	17.5	9.3	5.6	0.0	0.0	6.4	0.2	1.0	0.0	7.6
	B	62.4	0.0	0.0	0.0	16.2	8.6	5.2	0.0	0.0					
86SM9-09	A	76.2	0.0	0.0	0.0	14.3	6.9	2.5	0.0	0.0	3.0	0.0	1.8	0.0	4.8
	B	72.6	0.0	0.0	0.0	13.6	6.6	2.4	0.0	0.0					
86SM9-08	A	69.4	0.0	0.2	0.0	19.5	8.5	2.4	0.0	0.0	7.0	0.0	0.8	0.0	7.8
	B	64.0	0.0	0.2	0.0	18.0	7.8	2.2	0.0	0.0					
86SM9-07	A	81.2	0.0	0.2	0.0	8.7	7.9	1.9	0.0	0.0	4.2	0.0	1.4	0.6	6.2
	B	76.2	0.0	0.2	0.0	8.2	7.4	1.8	0.0	0.0					
86SM9-05	A	80.3	0.0	0.0	0.0	13.1	5.3	1.2	0.0	0.0	14.6	0.2	2.2	0.6	17.6
	B	66.2	0.0	0.0	0.0	10.8	4.4	1.0	0.0	0.0					
86SM9-03	A	79.1	0.0	0.0	0.0	13.2	5.2	2.5	0.0	0.0	26.0	0.0	1.0	0.2	27.2
	B	57.6	0.0	0.0	0.0	9.6	3.8	1.8	0.0	0.0					
86SM9-02	A	69.2	0.0	0.0	0.0	24.0	4.2	2.6	0.0	0.0	14.0	0.2	0.6	0.2	15.0
	B	58.8	0.0	0.0	0.0	20.4	3.6	2.2	0.0	0.0					
86SM9-01	A	69.5	0.0	0.2	0.0	18.9	6.8	4.7	0.0	0.0	5.0	0.0	0.6	0.0	5.6
	B	65.6	0.0	0.2	0.0	17.8	6.4	4.4	0.0	0.0					
86SM7-13	A	82.8	0.0	0.2	0.0	11.8	3.3	2.7	0.0	0.0	0.6	0.0	1.4	0.2	2.2
	B	81.0	0.0	0.2	0.0	10.8	3.2	2.6	0.0	0.0					

Table B3. (con.)

Sample no.	*	Vitrite	Liptite	Inertite	Durite	Clarite	Vitriner-tite	Duro-clarite	Claro-durite	Vitrinerto-liptite	Carbargi-lite	Carbo-pyrite	Carbanker-ite	Carbo-silicite	Total carbominera-lites
86SM7-11	A	74.1	0.0	0.0	0.0	15.0	9.0	1.8	0.0	0.0					
	B	64.2	0.0	0.0	0.0	13.0	7.8	1.6	0.0	0.0	12.4	0.6	0.4	0.0	13.4
86SM7-10	A	67.8	0.0	0.7	0.0	22.5	5.0	4.8	0.2	0.0					
	B	59.8	0.0	0.6	0.0	19.8	4.4	4.2	0.2	0.0	10.8	0.0	1.0	0.0	11.8
86SM7-09	A	76.6	0.2	0.2	0.0	13.9	5.9	3.3	0.0	0.0					
	B	70.6	0.2	0.2	0.0	12.8	5.4	3.3	0.0	0.0	4.2	0.0	3.4	0.2	7.8
86SM7-06	A	74.7	0.0	0.9	0.0	9.6	9.8	5.0	0.0	0.0					
	B	68.6	0.0	0.8	0.0	8.8	9.0	4.6	0.0	0.0	8.0	0.0	0.2	0.0	8.2
86SM7-04	A	77.0	0.0	0.0	0.0	16.9	5.0	1.2	0.0	0.0					
	B	64.8	0.0	0.0	0.0	14.2	4.2	1.0	0.0	0.0	14.4	0.4	1.0	0.0	15.8
86SM7-03	A	71.0	0.0	0.3	0.0	19.8	5.2	3.7	0.0	0.0					
	B	57.4	0.0	0.2	0.0	16.0	4.2	3.0	0.0	0.0	18.4	0.0	0.4	0.4	19.2
86SM7-01	A	55.6	0.0	1.6	0.2	18.8	15.7	8.2	0.0	0.0					
	B	49.0	0.0	1.4	0.2	16.6	13.8	7.2	0.0	0.0	11.0	0.0	0.8	0.0	11.8
86SM6-12	A	79.7	0.0	0.0	0.0	14.5	3.7	2.1	0.0	0.0					
	B	77.0	0.0	0.0	0.0	14.0	3.6	2.0	0.0	0.0	3.0	0.2	0.2	0.0	3.4
86SM6-11	A	75.6	0.0	0.2	0.0	15.4	6.1	2.7	0.0	0.0					
	B	61.8	0.0	0.2	0.0	12.6	5.0	2.2	0.0	0.0	17.2	0.0	1.0	0.0	18.2
86SM6-09	A	72.5	0.0	0.2	0.0	13.4	9.4	4.5	0.0	0.0					
	B	70.6	0.0	0.2	0.0	13.0	9.2	4.4	0.0	0.0	2.0	0.2	0.4	0.0	2.6
86SM6-07	A	61.2	0.0	0.6	0.0	21.1	11.5	5.5	0.0	0.0					
	B	57.4	0.0	0.6	0.0	19.8	10.8	5.2	0.0	0.0	6.0	0.2	0.0	0.0	6.2

Table B3. (con.)

C. Beluga Formation

Sample no.	a	Vitrite	Liptite	Inertite	Durite	Clarite	Vitriner-tite	Duro-clarite	Claro-durite	Vitrinerto-liptite	Carbargi-lite	Carbo-pyrite	Carbanker-ite	Carbo-silicite	Total carbominera-lites
86SM06-5	A	62.2	0.0	0.9	0.2	13.5	13.3	8.3	1.5	0.0	9.0	0.0	0.0	0.4	8.4
	B	57.0	0.0	0.8	0.2	12.4	12.2	7.6	1.4	0.0					
86SM06-3	A	66.7	0.0	1.1	0.0	16.8	10.9	4.6	0.0	0.0	8.0	0.0	0.2	0.0	8.2
	B	61.2	0.0	1.0	0.0	15.4	10.0	4.2	0.0	0.0					
86SM06-1	A	62.5	0.0	0.0	0.0	14.9	16.7	5.9	0.0	0.0	11.4	0.0	0.0	0.0	11.4
	B	55.4	0.0	0.0	0.0	13.2	14.8	5.2	0.0	0.0					
86SM05-8	A	61.2	0.0	0.0	0.0	29.1	4.3	5.4	0.0	0.0	6.4	0.0	4.2	0.2	10.8
	B	54.6	0.0	0.0	0.0	26.0	3.8	4.8	0.0	0.0					
86SM05-5	A	71.1	0.0	0.0	0.0	21.5	3.4	4.0	0.0	0.0	38.6	1.8	0.0	0.0	40.4
	B	42.4	0.0	0.0	0.0	12.8	2.0	2.4	0.0	0.0					
86SM04-5	A	67.6	0.0	0.0	0.0	23.8	7.3	1.4	0.0	0.0	23.4	0.2	2.4	0.0	26.0
	B	50.0	0.0	0.0	0.0	17.6	5.4	1.0	0.0	0.0					
86SM04-4	A	77.2	0.4	0.4	0.0	13.9	6.4	1.9	0.0	0.0	45.2	0.0	1.4	0.0	46.6
	B	41.2	0.2	0.2	0.0	7.4	3.4	1.0	0.0	0.0					
86SM04-3	A	62.6	0.0	0.2	0.2	10.3	19.8	7.0	0.0	0.0	2.2	0.0	0.6	0.0	2.8
	B	60.8	0.0	0.2	0.2	10.0	19.2	6.8	0.0	0.0					
86SM04-2	A	84.0	0.0	0.0	0.0	11.1	3.9	1.0	0.0	0.0	38.2	0.2	0.2	0.2	38.8
	B	51.4	0.0	0.0	0.0	6.8	2.4	0.6	0.0	0.0					
86SM04-1	A	76.5	0.0	0.0	0.2	14.9	5.4	3.0	0.0	0.0	16.6	0.0	2.6	0.0	19.2
	B	61.8	0.0	0.0	0.2	12.0	4.4	2.4	0.0	0.0					
86SM03-5	A	78.2	0.0	0.0	0.0	11.6	7.9	2.8	0.0	0.0	12.2	0.0	1.4	0.0	13.6
	B	67.6	0.0	0.0	0.0	10.0	6.8	2.4	0.0	0.0					
86SM03-2	A	75.1	0.0	0.0	0.0	15.9	6.5	2.5	0.0	0.0	3.6	0.0	0.8	0.0	4.4
	B	71.8	0.0	0.0	0.0	15.2	6.2	2.4	0.0	0.0					
86SM03-1	A	71.7	0.0	0.0	0.0	21.0	4.8	2.5	0.0	0.0	13.2	0.0	0.0	0.0	13.2
	B	62.2	0.0	0.0	0.0	18.2	4.2	2.2	0.0	0.0					
86SM02-3	A	71.7	0.0	0.0	0.0	20.8	3.3	4.3	0.0	0.0	1.8	0.0	0.0	0.0	1.8
	B	70.4	0.0	0.0	0.0	20.4	3.2	4.2	0.0	0.0					
86SM02-1	A	77.3	0.0	0.0	0.0	16.5	4.1	2.1	0.0	0.0	1.4	0.0	1.6	0.2	3.2
	B	74.8	0.0	0.0	0.0	16.0	4.0	2.0	0.0	0.0					
86SM01-3	A	71.7	0.0	0.0	0.0	23.0	2.8	2.5	0.0	0.0	12.6	0.4	0.0	0.0	13.0
	B	62.4	0.0	0.0	0.0	20.0	2.4	2.2	0.0	0.0					
86SM01-1	A	74.3	0.0	0.4	0.0	19.5	2.7	3.1	0.0	0.0	10.0	0.2	0.4	0.0	10.6
	B	66.4	0.0	0.4	0.0	17.4	2.4	2.8	0.0	0.0					
86SM05-1	A	71.9	0.0	0.0	0.0	17.2	6.8	4.0	0.0	0.0	14.8	0.0	0.4	0.0	15.2
	B	61.0	0.0	0.0	0.0	14.6	5.8	3.4	0.0	0.0					
KL0002	A	59.2	0.0	0.2	0.0	27.6	6.2	6.8	0.0	0.0	7.8	0.0	1.4	0.2	9.4
	B	53.6	0.0	0.2	0.0	25.0	5.6	6.2	0.0	0.0					
KL0007	A	68.8	0.0	0.0	0.3	26.5	1.3	2.9	0.0	0.0	18.0	0.0	6.2	0.2	24.4
	B	52.0	0.0	0.0	0.2	20.0	1.0	2.2	0.0	0.0					

Table B3. (con.)

Sample no.	*	Vitrite	Liptite	Inertite	Durite	Clarite	Vitriner-tite	Duro-clarite	Claro-durite	Vitrinerto-liptite	Carbargi-lite	Carbo-pyrite	Carbanker-ite	Carbo-silicite	Total carbominera-lites
KL0008	A	74.3	0.2	0.0	0.0	22.5	1.8	1.4	0.0	0.0					
	B	64.6	0.2	0.0	0.0	19.6	1.6	1.2	0.0	0.0	5.8	0.0	6.4	0.8	13.0
KL0010	A	84.1	0.0	0.0	0.0	13.8	1.6	0.5	0.0	0.0					
	B	72.0	0.0	0.0	0.0	11.8	1.4	0.4	0.0	0.0	13.4	0.2	0.6	0.2	14.4
KL0012	A	73.1	0.0	0.0	0.0	18.0	4.5	3.6	0.0	0.0					
	B	65.6	0.0	0.0	0.0	16.2	4.0	3.2	0.0	0.0	8.8	0.4	0.6	0.4	10.2
KL0014	A	70.7	0.0	0.0	0.0	22.7	2.6	4.0	0.0	0.0					
	B	60.4	0.0	0.0	0.0	19.4	2.2	3.4	0.0	0.0	6.8	0.6	6.2	1.0	14.6
KL0016	A	72.9	0.0	0.0	0.0	21.0	2.8	3.3	0.0	0.0					
	B	66.8	0.0	0.0	0.0	19.2	2.6	3.0	0.0	0.0	6.8	0.0	1.6	0.0	8.4
KL0017	A	60.5	0.0	0.0	0.0	31.9	2.5	5.1	0.0	0.0					
	B	52.4	0.0	0.0	0.0	27.6	2.2	4.4	0.0	0.0	11.4	0.4	0.4	1.2	13.4
KL0018	A	63.1	0.0	0.0	0.0	32.1	1.7	3.1	0.0	0.0					
	B	53.0	0.0	0.0	0.0	27.0	1.4	2.6	0.0	0.0	11.0	0.0	4.2	0.8	16.0
86SH14-04	A	70.1	0.0	0.0	0.0	24.9	1.9	3.0	0.0	0.0					
	B	64.8	0.0	0.0	0.0	23.0	1.8	2.8	0.0	0.0	5.2	0.2	1.8	0.4	7.6
86SH14-01	A	64.6	0.0	0.2	0.0	28.4	2.3	4.6	0.0	0.0					
	B	62.4	0.0	0.2	0.0	27.4	2.2	4.4	0.0	0.0	2.8	0.0	0.4	0.2	3.4
86SH13-01	A	91.9	0.0	0.0	0.0	6.3	1.0	0.8	0.0	0.0					
	B	72.6	0.0	0.0	0.0	5.0	0.8	0.6	0.0	0.0	4.6	16.4	0.0	0.0	21.0

Table B4. Detailed listing of vitrinite reflectance values ($\bar{R}o_{max}$) for coals of the southern Kenai Peninsula.

Sample	Point-count frequency distribution					$\bar{R}o_{max}$ (%)
	V1	V2	V3	V4	V5	
JL52-01			50			0.337
JL51-01	3	27	20			0.274
JL33-01			38	12		0.374
JL31-01		6	37	7		0.346
JL30-01			33	17		0.381
JL29-01		35	14	1		0.275
JL27-01		27	20	3		0.304
JL26-01		17	33			0.312
JL25-03			25	25		0.394
JL25-01		32	18			0.279
JL23-01		31	18	1		0.279
JL22-01		13	35	2		0.318
JL21-01			33	17		0.386
JL19-01	2	37	11			0.263
JL18-01	1	38	8	3		0.266
JL16-01			41	9		0.365
JL15-01		44	6			0.269
JL14-01		36	14			0.270
JL09-01			50			0.343
JL08-01		22	24	4		0.311
JL07-01		13	33	4		0.326
JL06-01			34	16		0.381
JL05-01		24	25	1		0.290
JL03-01	3	23	23	1		0.281
JL02-01		21	29			0.308
GR03-01		10	39	1		0.326
JL49-01	3	22	21	4		0.297
JL48-01		1	42	7		0.356
JL47-01	3	22	23	2		0.292
JL45-01			30	20		0.387
JL42-01		20	24	6		0.313
JL41-01		5	45			0.335
JL38-01		14	31	5		0.320
JL34-02		16	32	2		0.320
JL34-01		21	27	2		0.311
JL54-01			31	19		0.377
JL57-01			39	11		0.382
JL59-01		14	33	2	1	0.329
SM13-1		1	35	13	1	0.370
SM14-1			16	34		0.409
SM14-4			13	35	2	0.417
KL0018			25	25		0.400
KL0017			28	22		0.387
KL0016			39	11		0.378
KL0014			19	31		0.417
KL0012			22	28		0.395

Table B4 (con.)

Sample	Point-count frequency distribution					$\bar{R}o_{max}$(%)
	V1	V2	V3	V4	V5	
KL0010		3	34	13		0.353
KL0008		1	36	12	1	0.364
KL0007			34	16		0.371
SM15-1			12	34	4	0.424
KL0002		9	39	2		0.327
SM02-1			18	32		0.408
SM02-3		1	31	18		0.379
SM01-1			38	12		0.375
SM01-3		3	41	6		0.343
SM03-1		14	31	5		0.325
SM03-2			43	7		0.360
SM03-5		19	20	8	3	0.310
SM04-1		28	22			0.291
SM04-2		33	15	2		0.285
SM04-3	2	17	27	4		0.312
SM04-4			27	23		0.388
SM04-5	1	24	23	2		0.306
SM05-5		2	40	8		0.361
SM05-8			11	38	1	0.421
SM06-1		9	33	8		0.344
SM06-3		3	34	12	1	0.369
SM06-5			22	28		0.400
SM06-7			15	35		0.415
SM06-9			29	21		0.382
SM06-11		20	26	4		0.313
SM06-12		13	29	8		0.340
SM07-1		11	30	6	3	0.347
SM07-3		13	29	8		0.330
SM07-4		40	10			0.277
SM07-6			32	17	1	0.379
SM07-9	1	19	29	1		0.300
SM07-10			38	11	1	0.372
SM07-11		24	26			0.297
SM07-13			33	17		0.375
SM09-1		12	32	6		0.335
SM09-2		4	28	17	1	0.366
SM09-3	5	27	17	1		0.274
SM09-5	1	13	33	3		0.323
SM09-7			17	33		0.409
SM09-8		32	17	1		0.291
SM09-9			30	20		0.379
SM09-10		24	26			0.299
SM09-11	1	13	35	1		0.317
SM09-13		1	39	10		0.363
SM10-1		21	28	1		0.308
SM10-2		1	32	16	1	0.387
SM10-3	2	27	19	2		0.288

Table B4 (con.)

Sample	Point-count frequency distribution V1	V2	V3	V4	V5	$\bar{R}o_{max}$(%)
SM10-5		28	18	3	1	0.301
SM10-7	1	15	29	5		0.323
SM10-9	2	35	13			0.275
SM11-1		6	42	2		0.334
SM11-2	1	34	14	1		0.280
SM11-5	6	42	2			0.237
SM12-1		33	16	1		0.284

Table B5. Major-oxide geochemical data for ash samples of southern Kenai Peninsula coals.

Sample	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	Na_2O	K_2O	TiO_2	MnO	P_2O_5
JL 08-01	52.12	17.77	3.74	4.30	10.72	2.71	1.40	0.76	0.08	0.49
JL 15-01	49.36	19.17	6.80	4.04	10.06	1.21	1.49	0.82	0.10	0.01
JL 16-01	58.05	19.67	5.22	2.46	3.72	1.53	2.41	0.90	0.05	0.03
JL 21-01	51.91	20.73	4.98	2.56	8.41	0.76	1.65	0.98	0.14	0.08
JL 22-01	53.82	17.37	5.03	3.54	8.66	2.79	1.61	0.85	0.07	0.09
JL 25-01	47.47	17.15	7.18	4.73	8.97	3.09	1.12	0.78	0.18	1.03
JL 25-03	45.33	17.47	7.27	6.03	12.65	0.67	1.08	0.79	0.17	0.45
JL 26-01	56.84	14.37	10.24	2.96	4.63	2.28	1.47	0.76	0.17	0.22
JL 27-01	42.50	18.18	5.46	5.44	13.18	2.95	1.49	0.79	0.10	0.72
JL 29-01	37.29	13.47	11.81	4.60	18.78	0.81	1.00	0.60	0.39	0.99
JL 30-01	53.80	17.93	6.21	3.46	7.54	1.67	1.39	0.79	0.10	0.64
JL 42-01	46.05	19.29	5.81	6.62	13.95	0.84	1.24	0.69	0.25	0.28
JL 45-01	39.54	21.71	5.26	5.54	16.43	1.04	0.82	0.81	0.13	0.92
JL 48-01	50.40	22.85	4.47	4.73	9.05	1.37	1.48	0.98	0.11	0.27
SM 02-1	34.73	18.45	8.29	2.39	17.74	3.90	1.29	0.88	0.12	1.60
SM 02-3	33.49	17.91	7.42	4.57	19.12	0.42	1.16	0.67	0.13	1.88
SM 03-2	33.55	17.38	8.39	3.67	20.56	0.71	1.37	0.63	0.19	2.00
SM 04-3	35.88	11.01	9.19	7.86	20.75	0.44	0.96	0.57	0.12	0.53
SM 04-4	59.60	19.91	5.03	2.81	3.20	1.30	1.77	0.96	0.04	0.05
SM 06-1	39.42	22.07	3.91	2.80	12.88	4.45	1.79	0.77	0.06	2.95
SM 06-3	40.44	20.11	6.48	2.57	14.16	3.71	2.30	0.60	0.08	0.92
SM 06-5	45.21	22.04	4.56	2.72	9.44	3.16	2.58	0.79	0.12	1.70
SM 09-1	25.97	15.43	9.10	7.72	23.48	0.40	0.95	0.61	0.20	3.06
SM 09-2	48.78	18.20	6.35	3.85	8.67	0.63	1.37	0.86	0.15	1.01
SM 09-3	54.14	18.76	7.21	3.44	4.59	1.24	1.91	0.75	0.12	0.27
SM 09-5	55.59	18.06	5.32	3.65	6.08	1.40	1.67	0.92	0.10	0.29
SM 09-10	34.52	18.38	7.95	7.66	17.18	0.38	1.08	0.65	0.35	2.42
SM 09-11	53.33	20.12	4.96	3.72	7.24	0.68	1.75	0.87	0.13	0.50
SM 10-3	51.42	15.89	8.73	4.47	9.38	0.89	1.43	0.80	0.21	0.44
SM 11-1	40.04	16.89	7.57	4.01	15.55	1.21	1.04	0.65	0.18	2.13
SM 11-2	49.38	18.23	5.82	4.96	9.93	0.71	1.62	0.85	0.26	1.31

Table B6. Trace-element geochemical data for ash samples of southern Kenai Peninsula coals.

Sample	Cr	Ni	Co	V	Cu	Zr	Ba	Sr	Be	Zn	Pb	Cd
JL 08-01	118	100	89	259	213	154	1900	935	1.8	43	<50	<10
JL 15-01	146	117	113	305	251	91	1565	520	1.5	90	55	<10
JL 16-01	179	80	52	320	159	185	1255	238	2.1	113	83	<10
JL 21-01	161	82	229	406	294	217	1030	360	2.4	60	55	<10
JL 22-01	170	100	111	320	160	195	1525	470	1.9	73	<50	<10
JL 25-01	148	67	203	253	138	191	3760	1405	1.9	43	<50	<10
JL 25-03	220	114	190	279	138	209	2245	1065	2.2	30	60	<10
JL 26-01	127	75	50	282	78	250	1335	450	1.9	50	68	<10
JL 27-01	360	199	97	425	337	201	4055	1175	2.3	28	58	<10
JL 29-01	267	159	221	325	196	167	3630	1570	2.1	50	<50	<10
JL 30-01	129	114	91	230	107	195	2100	1090	1.8	93	55	<10
JL 42-01	289	143	63	311	170	151	2675	820	2.2	33	<50	<10
JL 45-01	423	152	104	707	333	109	1370	860	1.0	33	80	<10
JL 48-01	247	112	254	430	303	160	1975	515	2.7	25	<50	<10
SM 02-1	225	153	85	413	286	292	6575	3315	2.7	38	<50	<10
SM 02-3	703	493	89	481	306	252	5845	2505	4.0	43	68	<10
SM 03-2	625	198	51	365	247	171	5445	3135	4.1	60	60	<10
SM 04-3	974	300	86	547	138	501	3135	1100	2.3	53	53	<10
SM 04-4	190	86	50	353	145	230	1040	190	1.9	88	55	<10
SM 06-1	467	149	105	378	192	165	7665	6045	4.0	60	73	<10
SM 06-3	746	242	79	289	167	187	4730	3075	2.4	70	68	<10
SM 06-5	429	175	45	355	185	158	3685	2345	2.3	105	53	<10
SM 09-1	1214	270	58	335	278	149	7785	3455	2.2	48	60	<10
SM 09-2	1046	287	31	481	331	207	2980	1180	1.9	50	83	<10
SM 09-3	199	84	50	407	160	288	1540	445	2.1	118	68	<10
SM 09-5	247	120	50	556	184	364	1515	455	2.3	80	68	<10
SM 09-10	964	270	60	324	192	144	4915	2690	1.8	23	73	<10
SM 09-11	183	103	50	394	162	189	1925	480	2.5	68	<50	<10
SM 10-3	290	125	27	453	196	449	1800	650	1.9	53	68	<10
SM 11-1	618	224	68	579	151	292	4815	2490	3.3	38	80	<10
SM 11-2	802	253	53	380	142	185	3330	610	2.2	43	58	<10

APPENDIX C. CLASTIC-ROCK ANALYSIS DATA.

Table C1. Detailed listing of model-mineralogical analysis results of southern Kenai Peninsula sandstone samples.

	Cook Inlet Sterling Formation								Kachemak Bay Beluga Formation						Kachemak Bay Sterling Formation										
Detrital grains	86JL 53-1	86JL 20-2	86JL 20-1	86JL 18-2	86JL 44-1	86JL 42-2	86JL 41-2	86JL 35-1	86SM 13-2	86SM 14-5	86SM 02-2	86SM 01-4	86SM 05-12	86SM 06-4	86SM 03-4	86SM 04-6	86SM 06-10	86SM 07-5	86SM 07-14	86SM 09-6	86SM 09-14	86SM 10-4	86SM 12-2	86SM 12-3	86SM 12-4
Undulose quartz	7.5	15.5	22.0	27.5	24.3	15.0	15.3	13.8	26.5	17.8	9.3	8.8	12.0	19.8	15.5	27.3	18.5	23.8	21.8	19.3	34.0	19.8	40.0	19.0	12.3
Non-undulose quartz	1.5	7.5	5.3	5.0	9.0	2.3	3.0	4.0	5.8	7.0	5.8	2.8	3.3	4.8	4.0	5.5	5.8	9.0	9.0	3.8	5.5	5.8	5.8	3.8	1.8
Polycrystalline quartz	12.0	10.0	11.8	1.8	6.3	12.5	10.3	10.3	9.3	10.3	11.3	29.0	14.5	11.5	7.0	4.8	7.5	4.0	5.3	8.5	3.3	7.8	1.8	10.0	16.5
Potassium feldspar	3.3	7.3	6.8	8.3	7.5	3.5	3.8	5.5	6.0	10.5	4.8	0.5	1.8	4.0	4.8	6.3	3.8	4.0	6.0	4.5	3.8	4.0	1.5	2.8	3.0
Altered feldspar	4.3	6.3	4.8	6.3	6.5	2.8	3.3	1.8	4.8	4.5	1.3	1.3	1.3	1.8	1.5	3.3	2.0	0.8	0.8	1.3	1.3	1.5	1.0	1.5	1.0
Plutonic rock fragment-K spar	1.0	2.0	0.8	2.8	1.8	2.3	0.8	2.0	1.8	4.0	1.3	1.0	1.0	0.8	1.5	1.5	1.3	1.0	2.5	1.5	1.0	1.5	0.8	1.8	4.0
Plutonic rock fragment-quartz	1.0	1.3	1.0	3.5	2.3	0.8	2.8	2.8	1.5	3.8	1.8	1.0	0.5	1.0	1.3	1.5	1.5	1.0	1.8	1.5	1.3	3.5	1.8	2.3	4.0
Twinned or zoned plagioclase	2.3	3.3	7.5	6.8	4.8	5.0	2.3	1.3	3.5	4.0	5.3	0.5	1.5	2.0	2.8	6.3	3.8	3.0	1.8	5.0	2.5	3.3	3.3	2.8	2.8
Untwinned plagioclase	8.3	8.8	8.3	19.8	20.8	8.8	9.0	7.8	2.3	10.8	8.8	0.3	0.5	1.5	6.5	11.0	9.8	9.0	8.5	3.0	5.5	3.8	5.5	3.3	1.0
Quartz-mica schist/gneiss	1.3	1.0	0.5	0.8	0.3	1.0	1.0	2.3	1.5	2.3	3.8	3.5	8.8	3.0	2.8	2.3	1.5	2.8	2.0	1.5	4.0	1.0	3.8	5.5	6.0
Quartz-mica phyllite	1.5	0.8	1.0	1.0	0.5	1.5	2.0	5.0	5.0	3.8	3.0	4.8	7.0	7.5	2.3	0.5	1.5	1.5	0.3	2.0	1.5	3.0	2.3	8.3	10.0
Chert	1.0	1.3	1.5	0.3	0.0	1.3	1.5	3.8	0.5	2.5	2.3	11.3	5.8	2.8	3.3	1.0	2.0	0.8	0.5	1.3	1.3	1.5	0.0	4.3	4.8
Cherty argillite	7.0	5.5	1.8	1.8	1.5	6.0	7.3	6.3	4.8	5.3	10.0	8.5	10.5	11.3	4.8	4.5	5.3	7.0	5.5	5.8	9.8	6.3	5.8	9.3	11.0
Argillite	2.5	2.0	1.5	0.3	0.3	1.8	2.3	1.3	3.0	1.3	3.8	2.8	1.8	2.8	3.0	1.5	1.8	3.3	2.0	2.5	2.5	2.5	1.8	5.3	4.0
Siltstone	3.0	1.5	0.3	0.3	0.0	2.3	2.3	0.5	2.0	1.0	3.3	4.8	8.0	4.8	0.8	0.5	0.8	1.0	1.3	0.8	1.8	2.3	0.3	2.8	1.8
Slate/shale	2.5	0.5	1.5	0.3	0.5	1.5	1.5	1.3	3.8	2.0	4.3	6.8	6.0	7.3	2.3	1.0	1.8	2.3	1.8	2.8	2.8	2.3	0.8	5.5	5.5
Sandstone	2.8	4.8	0.5	0.5	0.3	4.5	3.5	2.5	5.0	4.5	3.3	11.8	13.5	4.8	3.3	1.0	2.3	4.5	2.3	4.8	3.0	3.3	1.5	3.5	5.0
Volcanic rock fragment or glass	29.5	13.8	19.8	1.3	1.0	22.8	23.8	19.0	5.3	2.8	15.5	0.8	1.3	3.8	25.0	12.5	25.8	9.5	17.5	21.0	5.3	16.5	5.5	0.0	1.0
Biotite	0.5	0.3	0.0	2.3	1.0	0.3	0.3	3.0	0.3	0.3	0.5	0.0	0.3	0.5	1.3	1.0	0.3	3.0	0.5	0.0	0.3	0.3	2.3	3.5	2.5
Hornblende	3.0	3.3	2.5	4.3	5.5	2.0	2.3	1.5	2.3	0.0	0.0	0.0	0.0	0.0	3.3	2.0	0.3	0.0	1.3	0.3	1.8	2.0	1.8	0.0	0.0
Clinopyroxene	2.0	1.3	1.0	3.0	2.8	0.8	0.0	0.8	1.3	0.0	0.0	0.0	0.0	0.0	0.8	1.8	1.8	0.8	3.3	0.3	1.0	0.5	2.0	0.0	0.0
Epidote	0.8	0.5	0.0	0.8	1.0	0.0	0.5	0.3	2.5	0.0	0.3	0.0	0.5	0.0	0.8	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
White-mica sericite	0.0	0.3	0.0	0.3	0.0	0.3	0.5	0.3	0.0	0.5	0.5	0.0	0.5	1.3	0.5	0.5	0.5	1.3	1.0	0.8	1.3	1.3	2.5	1.8	0.5
Coal/organics	1.3	0.8	0.0	0.8	0.3	0.3	0.3	0.8	1.0	0.0	0.0	0.3	0.0	2.3	1.0	2.0	1.0	6.5	2.8	3.8	3.5	3.5	4.0	1.8	0.8
Zircon	0.0	0.0	0.0	0.3	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5	0.3	0.5	0.5	0.3	0.0	0.8	0.5	0.5	0.3
Rutile	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.5	0.5	0.5	0.5	0.5	0.3	0.0
Chlorite	0.3	1.0	0.3	0.8	2.3	1.0	0.8	1.0	0.5	0.0	0.5	0.0	0.0	0.8	0.3	0.0	0.0	0.0	0.0	2.5	2.0	2.0	3.5	1.0	0.8
Carbonate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.5	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.3	0.0	0.0

Table C2. Geochemical and physical characterization data for coal-overburden samples of the southern Alaska Peninsula.

Sample no.	pH units	EC mmho/cm	OM %	CEC meq/100gm	Silt %	Sand %	Clay %	Class	Ca meq/L	Na meq/L	Mg meq/L	NO_3 ppm	PO_4 ppm	K ppm	$CaCO_3$ %	Tot-S %	Pyr-S %
86JL10-01	7.75	.96	1.15	2.46	70	15	15	SiL	3.49	1.89	2.86	<.8	5.6	312.0	.8	.016	.007
86SM03-6	6.30	.27	5.95	31.39	43	23	34	CL	1.20	.54	.94	<.8	<2	296.0	.5	.037	.008
86SM05-2	6.76	1.50	14.3	32.94	36	16	48	C	1.00	16.14	.74	9.4	<2	166.0	.5	.123	.008
86SM05-9	7.47	1.05	4.67	17.54	52	14	34	SiCL	1.30	12.79	1.22	9.2	<2	148.0	-1.1	.037	.005
86SM06-6	7.40	6.50	3.61	15.28	35	35	30	CL	6.24	53.24	5.4	<.8	3.6	240.0	2.0	.043	.011
86SM06-8	7.82	1.85	2.23	15.04	50	6	44	SiC	1.35	17.57	.66	11.2	<2	199.0	.3	.027	.009
86SM07-2	7.13	.42	2.08	26.73	44	18	38	SiCL	1.20	2.45	.69	<.8	2.8	342.0	.8	.027	.007
86SM07-12	5.62	3.00	6.9	31.63	61	20	19	SiL	11.98	2.6	22.25	99.2	<2	541.0	-.2	.053	.006
86SM08-3	6.10	.89	2.48	15.4	43	10	47	SiC	2.50	4.58	1.51	<.8	<2	78.5	-.3	.051	.006
86SM09-4	7.54	.46	.98	11.08	54	36	10	SiL	1.70	.77	2.09	3.6	3.2	173.0	.7	.011	.003
86SM09-12	6.15	.55	3	17.43	64	15	21	SiL	1.80	.67	3.03	<.8	<2	117.0	.5	.029	.006
86SM10-6	6.17	.40	11.5	37.36	32	40	28	CL	1.60	.93	1.17	<.8	<2	132.0	-1.0	.096	.022
86SM11-3	5.92	.45	46.5	27.31	37	50	13	L	1.80	1.1	2.93	<.8	2.4	147.0	.7	.194	.004
86SM12-4	6.23	.38	19	74.31	58	26	16	SiL	1.40	.64	1.89	5.6	5.6	66.1	.2	.064	.009
KL06-9	7.15	1.20	11.8	23.39	25	24	51	C	.80	13.4	.87	<.8	<2	158.0	.8	.112	.008
KL06-14	6.37	.94	37.4	29.00	28	32	40	CLC	2.30	4.23	3.13	<.8	<2	173.0	2.4	.093	.022
KL0007	7.55	2.20	15.1	28.05	21	40	39	CL	.90	24.45	.9	11.6	<2	180.0	-2.0	.091	.032
86JL01-01	7.56	.95	1.7	17.43	72	12	16	SiL	1.30	6.66	1.61	11.6	2.0	349.0	.9	.029	.012
86JL04-02	7.97	.82	1.89	17.78	73	16	11	SiL	1.00	7.12	.95	<.8	<2	455.0	.0	.029	.006
86JL15-02	7.21	.30	2.08	15.4	71	17	12	SiL	1.30	.84	.89	<.8	<2	152.0	.6	.021	.005
86JL19-02	7.18	.95	4.42	34.61	57	8	35	SiCL	3.89	1.94	3.09	<.8	<2	393.0	.3	.045	.007
85JL25-02	7.76	3.40	1.2	21.96	72	18	10	SiL	1.70	31.45	3.37	<.8	<2	591.0	.6	.048	.006
86JL31-04	7.99	.56	.87	13.75	65	22	13	SiL	1.20	3.05	1.2	2.4	<2	402.0	-4.7	.011	.002
86JL34-03	7.19	.68	3.8	34.37	53	11	36	SiCL	1.70	3.9	1.42	<.8	<2	189.0	-4.8	.027	.008
86JL39-03	6.91	.65	4.42	26.38	35	30	35	CL	2.30	1.2	2.37	2.5	2.0	335.0	.3	.048	.009
86JL45-02	7.67	.57	1.76	14.23	58	20	22	SiL	2.30	.71	2.34	1.6	<2	277.0	.1	.021	.005
86JL49-02	7.23	.75	1.51	18.26	69	11	20	SiL	1.00	4.72	1.5	<.8	2.0	638.0	.3	.027	.005
86JL52-02	7.02	.45	9.22	19.57	42	17	41	SiC	1.40	.77	2.22	<.8	3.2	217.0	1.0	.037	.010
86JL54-02	6.30	6.40	8.85	16.28	22	1	77	C	2.89	57.42	7.7	<.8	<2	245.0	.4	.112	.014
86JL22-02	7.58	2.8	2.06	21.72	52	15	33	SiCL	5.29	13.75	6.98	21.2	2.0	564.0	0.0	.021	.005

Table C2. (con.)

Sample no.	SO_4-S %	Org-S %	ABP Tot-S	ABP Pyr-S	Sat %	NH_4Na meq/100gm	ESP	SAR	B ppm	Cu ppm	Pb ppm	Mo ppm	Se ppm
86JL10-01	<.02	0.00	8.02	7.67	71.68	.24	4.25	1.06	.75	36.1	<2.5	.8	.02
86SM03-6	<.02	.01	4.54	4.83	69.17	.18	.45	.52	1.00	29.0	3.1	.5	.06
86SM05-2	<.02	.09	1.87	4.83	58.90	3.2	6.83	17.30	8.65	24.9	3.7	.7	.22
86SM05-9	<.02	0.01	-11.54	-11.15	47.92	2.88	12.93	11.39	2.25	26.4	3.7	<.5	.16
86SM06-6	<.02	0.01	19.44	19.81	55.98	2.46	-3.41	22.07	1.35	26.0	2.9	.5	.10
86SM06-8	<.02	0.00	2.86	2.79	66.87	1.56	2.56	17.53	1.00	25.7	5.5	<.5	.07
86SM07-2	<.02	0.00	6.88	6.87	73.42	.35	.64	2.52	1.35	25.1	2.9	.5	.03
86SM07-12	<.02	.03	-3.00	-2.14	66.46	.18	.02	.63	2.80	15.0	<2.5	<.5	.16
86SM08-3	<.02	.02	-3.92	-3.15	64.90	.36	.41	3.23	2.10	18.7	<2.5	<.5	.05
86SM09-4	<.02	0.00	7.38	6.99	49.18	.12	.74	.56	1.40	14.5	<2.5	<.5	.01
86SM09-12	<.02	.00	4.79	4.89	60.30	.12	.46	.43	1.00	31.0	<2.5	.7	.05
86SM10-6	<.02	.05	-12.37	-10.68	77.40	.18	.29	.79	2.10	34.1	2.7	1.0	.04
86SM11-3	<.02	.17	1.65	6.96	88.23	.22	.45	.72	5.50	11.9	5.8	.6	.06
86SM12-4	<.02	.03	.69	1.78	63.19	.13	.12	.50	2.95	26.1	5.3	.5	.06
KL06-9	<.02	.08	5.22	7.84	61.88	2.79	8.38	14.66	2.65	26.9	5.1	<.5	.07
KL06-14	<.02	.05	21.88	23.48	58.28	.41	.56	2.57	5.15	23.7	3.1	.5	.01
KL0007	<.02	.04	-22.25	-21.04	51.84	3.67	8.57	25.77	3.00	11.2	<2.5	<.5	.14
86JL01-01	<.02	0.00	8.81	8.72	60.79	.81	2.32	5.52	1.35	20.2	<2.5'	1.4	.10
86JL04-02	<.02	.00	-.24	-.13	56.14	1.22	4.61	7.21	1.00	18.7	<2.5	1.0	.06
86JL15-02	<.02	0.00	6.04	5.93	60.94	.2	.97	.80	.22	28.2	<2.5	.5	.07
86JL19-02	<.02	.02	2.28	2.85	98.68	.26	.20	1.04	.75	56.2	3.7	.8	.07
85JL25-02	<.02	.02	5.21	5.90	61.85	2.4	2.07	19.75	.50	16.7	<2.5	.6	.16
86JL31-04	<.02	0.00	-46.88	-47.23	73.30	.53	2.23	2.78	1.05	11.2	<2.5	<.5	.08
86JL34-03	<.02	0.00	-48.38	-48.42	81.53	.17	-.43	3.12	<.25	23.5	<2.5	<.5	.14
86JL39-03	<.02	.02	2.19	2.79	66.76	.18	.38	.79	1.25	29.3	5.3	1.1	.19
86JL45-02	<.02	0.00	1.02	.90	68.00	.13	.57	.47	.40	24.6	3.7	1.4	.23
86JL49-02	<.02	.00	2.86	2.91	70.73	.76	2.33	4.22	1.75	20.9	<2.5	.5	.23
86JL52-02	<.02	.01	9.56	9.79	65.60	.16	.56	.57	1.00	36.5	4.8	<.5	.17
86JL54-02	<.02	.08	1.20	3.64	82.94	3.12	-10.09	24.95	2.65	33.7	7.5	1.3	.29
86JL22-02	<.02	0.00	-.04	-.16	92.18	1.2	-.31	5.55	.50	33.9	4.2	1.8	.28