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COAL INVESTIGATIONS ON THE NORTHWEST MARGIN OF THE HOMER DISTRICT, KENAI COAL FIELD, ALASKA, IN 1950

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

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INTRODUCTION

The present report presents the results of work done in part of the 1950 field season and supplements reports by Barnes (1949) and Cobb (1950) on coal investigations on the southern and southwest margins of the Homer district. Barnes' report covers investigations of coal-bearing rocks of the Kenai formation of Tertiary age in a coastal belt between Bluff Point, 1-1/2 miles west of Homer, and the head of Kachemak Bay. Cobb's report deals with similar rocks exposed along the shore between Bluff Point and Deep Creek. The present report covers an extension of this work from Deep Creek along the east shore of Cook Inlet to the most northerly exposures of rocks of the Kenai formation in the beach bluffs about 6 miles south of the mouth of the Kasilof River. Outcrops of coal-bearing rocks along the Sterling Highway and the lower reaches of the Ninilchik River also were investigated. The writer, assisted by F. J. Markewicz, carried on the field work which is the basis for this report between June 1 and August 12, 1950. Field work comprised measurement of stratigraphic sections, tracing of coal beds, geologic mapping along the shore of Cook Inlet, the lower part of the Ninilchik River, and the Sterling Highway, and sampling of coal beds.

GENERAL DESCRIPTION OF THE AREA

Barnes (1949, p. 2) defined the Kenai coal field as the coal-bearing part of the Kenai lowland, which lies between the Kenai Mountains on the east and Cook Inlet on the west and extends from Turnagain Arm to Kachemak Bay. The part of the Kenai coal field south of Tustumena Lake and the Kasilof River, which drains it, was defined as the Homer district. The northwest margin of the Homer district is the subject of the present report.

The northwest part of the Homer district consists largely of a rolling swampy surface less than 200 feet in altitude. Deep Creek, the Ninilchik River, and the upper parts of some of the smaller streams meander through broad valleys dotted with oxbow lakes and muskeg ponds. The larger streams are underfit with respect to their modern valleys. The Kasilof River, which drains Tustumena Lake, is one of the largest streams of the Kenai Peninsula. Above its estuary it is swift and has several rapids, but can be navigated in a dory powered by a large outboard motor. Small streams that discharge directly into Cook Inlet flow through narrow, steep-walled ravines or cascade over nearly vertical bluffs to the beach. Wet-weather streams in the part of the area north of locality 122 (pl. 1) are notching the broad valleys that they cut at a time when they were graded to a base level a few tens of feet higher than present sea level. Such unadjusted streams and a few estuarine deposits of Recent age near the top of the low beach bluffs in the northern part of the Homer district are the only known evidence of recent deleveling (relative changes of sea level) in the area.

The climate of the Homer district (Barnes, 1949, p. 3) is characterized by cool summers, winters that are mild for the latitude, and low precipitation. July and August, the warmest months, have a mean temperature of 50° to 55° F.; January and December, the coldest months, of 13° to 23° F. The mean annual precipitation is about 17 inches at Kasilof and 27 inches at Homer.

The vegetation of the district [1] is varied and uneven in distribution. Fireweed, bluejoint (at least two species of Calamagrostis), putschke (Heracleum lanatum), and other weeds and grasses are widespread. Two species of spruce (Picea sitchensis and P. glauca) grow abundantly on well-drained terrane and in some of the smaller stream bottoms, but the trees are generally too small or too deformed for good lumber, though some are adequate for cabin logs and mine timbers. A third species of spruce, P. marianna, grows only in muskeg swamps and is economically worthless. Alder and elderberry in dense thickets grow near the margins of spruce forests and on some of the more gentle bluffs. Groves of cottonwood occur on the bottomlands of some of the larger streams. Tangled masses of devil's club (Echinopanax horridum) and nettles are common in shaded revines and among alder thickets. Other trees and shrubs of the area include several species of birch, aspen, willow, high-bush and low-bush cranberry, high-bush and low-bush blueberry, and salmonberry.

The village of Ninilchik is the principal settlement of the area covered by the present report. It, like the rest of the Kenai lowland, is served by Pacific Northern Airlines and Alaska Airlines. The Sterling Highway, which connects Homer at the southern end of the Kenai lowland with the town of Kenai and with other roads leading to the Alaska Railroad and the city of Seward, passes through the outskirts of Ninilchik. Kasilof, at the northern limit of the Homer district, is a group of homesteads and a few business establishments scattered along both banks of the Kasilof River from the Sterling Highway downstream to the beach. Homer, the main supply point of the district, is the largest town of the Kenai lowland and has several stores, garages, and other business. It is served by the Alaska Steamship Company in addition to the two airlines. Kenai, a few miles north of the Homer district, also has several stores and is served by both airlines. Most supplies shipped into the area are trucked from either Seward or Homer or are brought by air from Anchorage. Small airfields are located at Ninilchik and Kasilof, and both Homer and Kenai have 5,000-foot gravel airstrips maintained and staffed by the Civil Aeronautics Authority. The only industry of the area is fishing. Part of the catch is sold to a small cannery at Ninilchik and to several larger canneries north of the area discussed in this report. A large part of the male population, when not fishing, is employed part or full time by the Alaska Road Commission. Most families raise part of their food in small garden plots.

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[1] The writer is indebted to W. S. Benninghoff, botanist, of the U. S. Geological Survey, for identification of many plants of the area.

STRATIGRAPHY

The only pre-Pleistocene formation exposed in the Homer district is the coal-bearing Kenai formation, which is the Tertiary age, and on the basis of plant fossils is placed in the Eocene series (Smith, 1939, p. 61). Quarternary sediments, including till and outwash, ice-contact, estuarine, and eolian deposits, and modern stream gravels, cover the greater part of the district. Bedrock is exposed only in the beach bluffs, in some stream beds, and in a few of the steeper slopes. Bedrock probably is near the surface at many places, however, because much of the mantle is colluvium composed of angular fragments of nonresistant rock types common in the Kenai formation.

The Kenai formation consists of partly indurated sand, silt, and clay in interfingering beds and lenses, with interstratified thin conglomerate lenses and many beds of subbituminous and lignitic coal less than 6 feet thick. Ferruginous masses are abundant in the formation in the southern part of the Homer district (Cobb, 1950, p. 4) but are very scarce in the area covered by this report. The proportion of sandstone in the Kenai formation is much greater in the northwest part of the district than farther south along Cook Inlet and on Kachemak Bay, but otherwise sections measured in different parts of the district are remarkably similar. This general stratigraphic similarity throughout the Homer district indicates that fairly uniform conditions obtained over the whole area during most of the time of deposition of the Kenai formation. On the other hand, the lenticularity of individual strata and rapid changes in grain size along the bedding indicate that at any one place conditions were constantly changing.

The total thickness of the Kenai formation is not known, as neither top nor base has been identified positively in the areas studied. The maximum known thickness in the Homer district is about 3,450 feet (Cobb, 1950, p. 4), which is the cumulative thickness of stratigraphic sections measured between Anchor Point and the head of Kachemak Bay. The 2,000 feet of beds exposed along the east shore of Cook Inlet south of Ninilchik probably duplicates part of the section east of Anchor Point (Cobb, 1950, p. 4). The amount of duplication in the stratigraphic sections measured between Deep Creek and the Kasilof River cannot be estimated because of lack of recognizable key beds, interruptions in continuity of outcrop by pre-Quanternary valleys cut in the Kenai formation, and faults of unknown displacement. For the same reasons sections south of Ninilchik cannot be correlated with those measured south of Deep Creek in 1949 (Cobb, 1950, map and stratigraphic sections).

Beds in secs. 4 and 9, T. 2N., R. 12 W., the northernmost exposures of pre-Quaternary rocks along the east coast of Cook Inlet, are probably younger than Tertiary strata exposed in other parts of the area. They are poorly indurated sandstone, siltstone, silty claystone, clay, and dull-brown, bony lignitic coal very different in appearance from the black, generally shiny coal found in other parts of the district. No sharp break between the poorly indurated sediments associated with the coal beds at these localities and the overlying till can be seen. In the absence of data to the contrary, the lower beds in sections measured at these localities are considered to be part of the Kenai formation, though the writer recognizes that they may be considerably younger, possibly correlative with the Miocene or Pliocene rocks on Kodiak Island that Capps (1937, pp. 153-155) described.

A small exposure of bony coal north of the Kasilof River and west of the Sterling Highway in sec. 30, T. 3 N., R. 11 W., is not properly in the Homer district, but is the only verified occurrence of rocks of the Kenai formation in the Kenai district of the Kenai coal field as defined by Barnes (1949, p. 2). This exposure is about 3 feet above normal river level and underlies an area of about 750 square feet from which the overburden has been stripped. It consists of about 2 feet of bony coal, bone, silty claystone, and sand.

STRUCTURE

The structure of the Kenai formation north of Deep Creek, as in other parts of the Homer district (Barnes, 1949, pp. 4-5; Cobb, 1950, pp 5-6), is relatively simple and is characterized by gentle folds, in which dips are everywhere less than 15° and generally less than 8°, superposed on a regional structure in which the strike is in most places about parallel to the shore and the dip is landward. Exceptions to this generalization, however, are found near faults, within a few feet of which are dips as steep as 30°.

Bedrock exposures are restricted to too narrow a belt to allow determination of the general trend of many folds, most of which are revealed only by reversals of the dip component visible in the beach bluffs. Such folds are shown on plate 2, with axes approximately at localities 62, 64, 77, 84, 86, and 95. The stratigraphic sections were plotted with reference to a true datum, the beach at approximate high-tide line, so the correlation lines reflect the structure. The only fold well enough exposed in three dimensions to permit even an approximate measurement of trend is the anticline at locality 72, which plunges N. 65° E. At locality 76 a syncline, too small to be shown on plate 2, has about the same trend but plunges in the opposite direction.

Many small normal faults cut the Kenai formation in the northwest part of the Homer district but are not shown on either the geologic map (pl, 1) or sections (pl. 2) because all have vertical displacements of less than 5 feet. Four such faults near localities 73 and one at locality 91 all strike about east and dip steeply to the north.

Other normal faults of much greater vertical displacement are indicated on plates 1 and 2 between localities 91 and 92, between localities 101 and 102, between localities 105 and 106, and at Clam Gulch. The fault between localities 91 and 92 is well exposed in the steep beach bluff. Coal beds on both sides of the fault show the effects of drag, which indicate that the northeast block was downthrown. No bed, however, can be correlated across the fault, so no valid estimate of the displacement can be made. The normal fault between localities 101 and 102 also is well exposed. Drag in the coal beds it cuts shows that the northeast block was downthrown. As with all the major normal faults in the area, no bed can be correlated across the fault, so no estimate of total displacement is possible, though a horse between the main fault and a small distributive fault indicates a minimum vertical movement of 22.5 feet. The inferred faults between localities 105 and 106 and at Clam Gulch are not exposed, but are postulated to account for discrepancies in stratigraphic sections measured on opposite sides of covered areas.

One high-angle reverse fault, with about 20 feet of vertical displacement, cuts the Kenai formation between localities 69 and 70. The actual fault surface is inaccessible, but it is clearly visible in the bluff. It strikes N. 45° E. and dips about 60° SW.

Exposures of rocks of the Kenai formation along the lower reaches of the Ninilchik River are restricted to places where meanders impinge directly on the valley wall, and to ungraded sections of tributaries that drain upland swamps and flow down the steep walls of the main valley. Between outcrops bedrock is covered by glacial deposits, colluvium, or soil.

The attitude of the beds exposed along the Ninilchik River is consistent with that of beds in the beach bluffs, so there is no apparent change in structual pattern for at least 3 miles inland from the shore near Ninilchik. Aerial reconnaissance for about 25 miles up Deep Creek from Cook Inlet showed beds of the Kenai formation dipping gently upstream in accord with the regional structure.

COAL BEDS

The coal of the northwest margin of the Homer district, like that of the rest of the district investigated to date (Barnes, 1949, p. 6; Cobb, 1950, pp. 6-7), occurs in many beds, all less than 6 feet thick and distributed throughout the thickness of the formation. Toward the northern part of the district, however, coal beds are more widely separated. South of Falls Creek it is difficult to find a 150-foot section without a coal bed; north of Falls Creek there are several barren intervals thicker than 200 feet. Coal beds near the north boundary of the Homer district also are much thinner and bonier than in other parts of the area, only one bed north of Clam Gulch containing as much as 1 foot of coal.

Analyses of coal from the vicinity of Homer, including several samples from the mine of the Homer Coal Corporation, show the coal to be subbituminous, with an average heating value of 9,980 Btu, air-dried, and to contain 4 to 20 percent ash (Barnes, 1949, p. 8). Unpublished analyses of coal from the southwest margin of the Homer district show an average heating value of 8,680 Btu, air-dried, and 9 to 17 percent ash content. Analyses of samples of two coal beds on the northwest margin of the district show coal from a bed at locality 69 to be subbituminous and coal from another at locality 99 to be lignite according to present standards of classification (Cooper, et al., 1946, pp. 20-22).

The analyses in the accompanying table indicate the best grade of coal likely to be found on the northwest margin of the Homer district. Because the coal beds sampled were those which appeared to have the least bone and other mineral impurities, the writer believes they should be considered as better than average rather than representative of coal in the area.

COAL RESERVES

The writer assumed all coal on the northwest margin of the Homer district to have a heating value of 8,370 Btu, air-dried, the average of all available analyses of coal samples collected north of Anchor Point. Therefore, according to the system prescribed by the U. S. Geological Survey for classification of public lands (Smith et al., 1913, pp. 69-70), areas underlain by coal in beds as thin as 2.8 feet (34 inches) could be classed as coal-bearing. The minimum thickness for calculating reserves in this area was chosen arbitrarily as 3 feet, even though past mining practice has shown that considerably thicker beds are necessary for profitable mining in Alaska.

Thicknesses shown in parentheses opposite coal beds in the stratigraphic and individual coal-bed sections (pls. 2 and 3) have been corrected for partings by the pricing method used by the U. S. Geological Survey (Smith et al, 1913, p. 70), which is based on the assumption that a given amount of coal in two or more benches is less valuable than if in a single bed.

Analyses of samples of coal from the northwest part of the Homer district, Alaska
(Analyses by H. M. Cooper, U. S. Bureau of Mines; sampling by
E. H. Cobb and F. J.Markewicz, 1950)

Lab. No.	Air-drying loss	Form of analyses 1/	Moisture	Volatile matter	Fixed Carbon	Ash	Sulfur	Heating value Btu	Source
	percent		percent	percent	percent	percent	percent		
D-49805	14.5	A	27.1	36.5	28.4	8.0	0.3	7,730	T.1S., R. 14W.,
		B	14.8	27.1	33.1	9.4	0.3	9,040	NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 26,
		C		50.1	38.9	11.0	0.4	10,610	2-5-foot bed,
		D		56.3	43.7		0.4	11,920	locality 69.
D-51010	17.2	A	27.1	31.3	25.4	15.7	0.2	6,640	T. 1. N., R. 12 W.,
		B	12.0	38.4	30.6	19.0	0.2	8,020	NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec 6,
		C		43.7	34.7	21.6	0.3	9,110	2.8-foot bed,
		D		55.7	44.3		0.3	11,620	locality 99.

1/ A, as received ; B, air-dried; C, moisture-free; D, moisture-and ash-free.

In the absence of more information on the island extension of potentially minable coal beds, the tonnage figures in the accompanying table were computed on the assumptions that each bed extends inland for a distance equal to half the known length of outcrop and that each bed maintains the same average thickness as at the outcrop. No reserves were calculated for coal exposed below high-tide level. Each acre-foot of coal was assumed to weigh 1,750 tons.

The tonnage figures given in the table are conservative and probably represent only a small fraction of the total coal in beds more than 3 feet thick on the northwest margin of the Homer district, but available data do not warrant estimates for entire townships. Careful examination of the valleys of the Ninilchik River and Deep Creek, supplemented by considerable exploratory drilling and trenching, will be required before coal reserves farther inland can be estimated with any degree of accuracy.

Indicated coal reserves in part of the Homer district, Kenai coal field, Alaska

Township and coal beds	Average Thickness (feet)	Aggregate Area (Across)	Tons	Totals (Tons)
T.2S., R. 14 W.				
1 bed, 3.0 - 3.9 feet	3.4	2.9	17,000	17,000
T. 1S., R. 14 W.				
2 beds, 4.0 - 4.9 ft.	4.2	45.2	333,000	
2 beds, 3.0 - 3.9 ft.	3.2	26.8	151,000	484,000
T. 1 N., R. 13 W.				
1 bed, more than 5 ft.	5.1	5.6	50,000	
4 beds, 3.0 - 3.9 ft.	3.4	123.4	734,000	784,000
T. 1 N., R. 12 W.				
1 bed, 3.0 - 3.9 ft.	3.7	89.2	578,000	578,000
T. 2N., R. 12 W.				
1 bed, 3.0 - 3.9 ft.	3.7	113.3	734,000	734,000
		Total		2,597,000

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