HB

41

Alaska State Legislature

REPRESENTATIVE
JEANNETTE JAMES
P.O. Box 56622
North Pole, Alaska 99705
(907) 488-1546
FAX (907) 488-9006

While In Juneau
State Capitol
Juneau, Alaska
99801-1182
(907) 465-3743
FAX (907) 465-2381

House of Representatives
House District 34

HB 41 Gates of the Arctic Sponsor Statement

1-23-95

This Bill repeals the section of AS 42.40.355 that prohibits the State owned railroad from using the Gates of the Arctic National Preserve as a transportation corridor. In order to build rail a grade of 3% is the maximum, this requirement necessitates use of the Gates of the Arctic National Preserve.

Attached is 16 U.S.C. 410 hh (b)-(e), which states that Congress finds a need for access across the Western (Kobuk River) unit of the Gates of the Arctic National Preserve, and directs the Secretary (of the Interior) to permit such access.

The Alaska Railroad is the logical long term transportation provider for natural resources from Fairbanks to Nome. Currently there is no transportation corridor from east to west in Alaska.

Chapter 83 SLA 94 (HB 183) is an act directing the DOT to identify and delineate a transportation corridor between the Seward Peninsula and Fairbanks. The repeal of the prohibition will allow the Congressional intent and State Law to be followed.

Alaska State Legislature

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JEANNETTE JAMES
P.O. Box 56622
North Pole, Alaska 99705
(907) 488-0862

House District 34

While in Juneau
State Capitol
Juneau, Alaska
99801-1182
(907) 465-3745

House Of Representatives

Sponsor Statement HB 182 & HB 183

By Rep. Jeannette James

HB 182 and HB 183 are intended to initiate preliminary and ultimately result in final action necessary to properly review, identify and survey the best options for the establishment of a transportation/utility corridor from the Interior's existing transportation distribution hub to the western area of the Seward Peninsula near Nome.

The future of Alaskans residing north of the Alaska Range will require expansion of our existing transportation infrastructure. With the recent completion by the State of Alaska of its remaining land selection allotment, the major land ownership patterns are now discernable. There are four separate interior to the coast corridors now being evaluated on state owned land.

This legislation will direct the Dept. of Transportation to perform aerial reconnaissance, photography, interpretation and surveying. The DOT in the attached position paper supports this work. This work will identify areas with transportation corridors to be established and which offer the best cost effective options to access this vast resource rich area of our state.

The apprpriation for this project is included in HB 182 and will authorize the expenditure of the funds necessary to secure this very important multi-model land use transportation corridor as a step that will move us forward to a more positive economic future for a very large portion of Alaska.

2.

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House Of Representatives

Sponsor Statement HB 182 & HB 183

By Rep. Jeannette James
Revised: 3/30/93

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House of Representatives
House District 34

MEMO

January 18 1995

To: Transportation Committee

From: Rep James

Re: Request for hearing on HB 41 Gates of the Arctic

Attn: Gary Davis Chair

Please schedule the above referenced Bill for a hearing at your earliest convenience.

Thompson TCC 452-8251 x 3227
[illegible] on Subsistence
to [illegible] 2
[illegible] field, [illegible] DNR 451-5000 Surveys
762-2165 [illegible]

Alaska State Legislature

REPRESENTATIVE
JEANNETTE JAMES
P.O. Box 56622
North Pole, Alaska 99705
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FAX (907) 488-9006

While In Juneau
State Capitol
Juneau, Alaska
99801-1182
(907) 465-3743
FAX (907) 465-2381

House of Representatives
House District 34

MEMO

January 19, 1995

To: Transportation Committee

From: Rep James

Re: Request for hearing on HB 41 Gates of the Arctic

Attn: Gary Davis Chair

Please schedule the above referenced Bill for a hearing at your earliest convenience.

A RESOLUTION

Supporting legislation to identify and delineate a transportation and utility corridor between Fairbanks and the Seward Peninsula for road, rail, pipeline, and electrical transmission purposes.

WHEREAS, House Bill 182 and House Bill 183 are now pending in the Alaska House of Representatives; and

WHEREAS, HB 183 directs the Northern Region of the Department of Transportation and Public Facilities to identify and delineate a transportation and utility corridor between Fairbanks and the Seward Peninsula; and

WHEREAS, the corridor would be sufficient to accommodate a road, an extension of the Alaska Railroad, pipelines for oil, natural gas, and coal slurries, and an electrical transmission line; and

WHEREAS, HB 182 appropriates $7.3 million to accomplish the purposes set out in HB 183; and

WHEREAS, the proposed corridor between Fairbanks and the Seward Peninsula would provide transportation access to highly mineralized areas of western Alaska; and

WHEREAS, HB 182 and HB 183 work in conjunction with previous actions by the Alaska Legislature to designate a rail corridor between Eielson AFB and the Canadian border; and

WHEREAS, the benefit to the greater Fairbanks area would be enormous as the hub of a rail network connecting the Seward Peninsula with Anchorage and the Lower 48 states through Canada;

NOW THEREFOR BE IT RESOLVED, that the Fairbanks Chamber of Commerce supports the passage of HB 182 and HB 183 by the second session of the 18th Alaska Legislature.

BE IT FURTHER RESOLVED, that copies of this resolution shall be sent to the appropriate committee chairmen in the Alaska House and Senate.

GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE

ALASKA

Albers Equal Area Projection

Scale 1:2,000,000

0 50 miles

This map illustrates the administrative boundary of the Gates of the Artic National Park and Preserve. Land status is not represented.

Index Map

WORK ORDER REQUEST FORM W.O. [19] LS-0203

KEYWORDS: TRANSPORTATION ASSIGNED: Utermohle

REQUEST FOR: New Bill TAKEN BY: Cook

SUBJECT: AK Railroad Right-of-Way thru Gates of Arctic

REQUESTED FOR: REP JAMES BY: Walt PHONE: 465-3743

DELIVER TO: Rep. James, Cap 501

INSTRUCTIONS: Delete statute that prohibits railroad right-of-way through Gates of the Arctic.

OBTAIN	SPECIAL DRAFTING INSTRUCTIONS ATTACHED [ ] AUTHORIZED TO CONFER WITH _____ RETURN _____ _____ TO REQUESTOR APPROVED: X DIRECTOR, LEGAL SERVICES

REVIEWED _____ IN 11/14/94 DUE _____ TYPED: Draft _____ Date _____ Final _____ Date _____ PROOFED _____ DELIVERED _____	SPECIAL INSTRUCTIONS to TYPING/PROOFING Request for DRAFT

Sponsor

ALDP1010[11/15/94]

FISCAL NOTE

STATE OF ALASKA **BILL NO.** HB 41

1995 LEGISLATIVE SESSION

Revision Date:		Dept. Affected:	DOT&PF
Title:	An Act Repealing prohibition against applications for a R/W across the Gates of the Arctic National Preserve	BRU:	Northern Region
		Component:	Design and Construction
Sponsor:	Representative Jeannette James		
Requester:	Representative Jennette James	**COMPONENT SERIAL NO.**	584

Expenditures/Revenues (Thousands of Dollars)

OPERATING EXPENDITURES	FY 96	FY 97	FY 98	FY 99	FY 00	FY 01
PERSONAL SERVICES	0.0	0.0	0.0	0.0	0.0	0.0
TRAVEL	0.0	0.0	0.0	0.0	0.0	0.0
CONTRACTUAL	0.0	0.0	0.0	0.0	0.0	0.0
SUPPLIES	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT	0.0	0.0	0.0	0.0	0.0	0.0
LAND & STRUCTURES	0.0	0.0	0.0	0.0	0.0	0.0
GRANTS, CLAIMS	0.0	0.0	0.0	0.0	0.0	0.0
MISCELLANEOUS	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL OPERATING	0.0	0.0	0.0	0.0	0.0	0.0
CAPITAL EXPENDITURES	0.0	0.0	0.0	0.0	0.0	0.0
CHANGE IN REVENUES ( )	0.0	0.0	0.0	0.0	0.0	0.0

FUND SOURCE (Thousands of Dollars)

1002 Federal Receipts	0.0	0.0	0.0	0.0	0.0	0.0
1003 GF Match	0.0	0.0	0.0	0.0	0.0	0.0
1004 GF	0.0	0.0	0.0	0.0	0.0	0.0
1005 GF/Program Receipts	0.0	0.0	0.0	0.0	0.0	0.0
1006 GF/MHTIA	0.0	0.0	0.0	0.0	0.0	0.0
Other	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0

Estimate of any current year (FY95) cost: $ 0.0

POSITIONS

FULL-TIME	0	0	0	0	0	0
PART-TIME	0	0	0	0	0	0
TEMPORARY	0	0	0	0	0	0

ANALYSIS: (Attach a separate page if necessary)

Will not impact the DOT&PF. This proposed legislation deals with the state owned railroad.

Prepared by:	Loren Rasmussen	Phone:	465-2960
Division:	Engineering and Operations Standards	Date:	01/24/95
Approved by Commissioner:	[signature]	Date:	01/24/95
Agency:	Department of Transportation and Public Facilities		

PREPARER TO PROVIDE ALL DISTRIBUTION COPIES TO GOVERNOR'S LEGISLATIVE OFFICE

For further distribution information, call the Governor's Legislative Office for commercial and other uses authorized under this chapter if the use does not restrict other parallel uses of the utility corridor.

(c) The corporation may lease, subject to AS 42.40.285 and (d) of this section, grant easements in or permits for, or otherwise authorize use of portions of rail land. However, the corporation may not convey its entire interest in rail land except as provided in AS 42.40.285, 42.40.370(d) and 42.40.400.

(d) A lease or disposal of land approved by the legislature under AS 42.40.285 by the corporation to a party other than the state shall be made at fair market value as determined by a qualified appraiser or by competitive bid. (§ 2 ch 153 SLA 1984)

Opinions of attorney general. — Alaska Const., art. VIII, § 10, requiring public notice of the leasing of state lands, requires that the Alaska Railroad give prior public notice whenever it proposes to lease railroad lands. The word "state" throughout article VIII encompasses all lands held in common by the political community of Alaskan citizens rather than only those lands nominally held by one of the principle departments of the executive branch. March 8, 1985, Op. Att'y Gen.

Lands belonging to the Alaska Railroad Corporation are not within "legislative designations" as that term is used in AS 38.05.800, regarding reconstitution and administration of mental health land trust, and accordingly may not be designated by the commissioner of natural resources as replacement mental health trust lands. November 17, 1987, Op. Att'y Gen.

Sec. 42.40.355. Prohibition. Notwithstanding any other provision in this chapter, the state-owned railroad as defined under 45 U.S.C. 1202(14) may not apply for a right-of-way across, or exercise eminent domain in, the western (Kobuk River) unit of the Gates of the Arctic National Preserve under 16 U.S.C. 410hh(4)(b) — (e). (§ 2 ch 153 SLA 1984)

Sec. 42.40.360. Request for land. (a) The board may nominate federal land it determines may be useful for present or future railroad purposes for selection under the Alaska Statehood Act (P.L. 85 — 508, 72 Stat. 339), as amended, and request the commissioner of natural resources to select the land for the state through the federal land selection process.

(b) The board may identify and request the commissioner of natural resources to convey land necessary or useful for present or future railroad purposes owned by or tentatively approved for transfer to the state, including land not contiguous with a railroad utility corridor or rail land. The request must include a statement of and justification for the present or future railroad use. Upon receipt of a request, the commissioner shall temporarily reserve the land identified in the request for railroad purposes and defer disposal or lease of that land under other laws to a party other than the corporation. The temporary reservation of land is subject to valid existing rights and remains in effect for 180 days. (§ 2 ch 153 SLA 1984)

CS FOR HOUSE BILL NO. 183(TRA)

IN THE LEGISLATURE OF THE STATE OF ALASKA

EIGHTEENTH LEGISLATURE - FIRST SESSION

BY THE HOUSE TRANSPORTATION COMMITTEE

Offered: 3/31/93
Referred: Resources, Finance

Sponsor(s): REPRESENTATIVE JAMES

A BILL

FOR AN ACT ENTITLED

"An Act directing the identification and delineation of a transportation and utility corridor between Fairbanks and the Seward Peninsula for road, rail, pipeline, and electrical transmission purposes; and providing for an effective date."

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF ALASKA:

* Section 1. FAIRBANKS - SEWARD PENINSULA TRANSPORTATION AND UTILITY CORRIDOR. (a) Not later than April 1, 1995, the northern region of the Department of Transportation and Public Facilities shall identify and delineate a proposed transportation and utility corridor between Fairbanks and the western end of the Seward Peninsula. The corridor shall be sufficient to accommodate construction of

(1) a road;

(2) an extension of the Alaska Railroad;

(3) oil, natural gas, or coal slurry pipelines, or any of them; and

(4) an electrical transmission line.

(b) In performing the work required by (a) of this section,

Chap 83 SLA 94
Chapter 83 SLA 94

(1) the railroad alignment and identification of a railroad right-of-way of not less than 500 feet shall guide the identification and delineation of the corridor; and

(2) the northern region shall consider the following factors:

(A) grade and alignment standards that are commensurate with rail and road construction standards;

(B) availability of construction materials;

(C) safety;

(D) service to adjacent communities;

(E) significant environmental concerns;

(F) use of public land to the maximum degree possible; and

(G) minimization of probable construction costs.

(c) Within 90 days after receiving a report transmitting the work of the northern region of the department under (a) of this section, the commissioner of transportation and public facilities shall, in conformity with AS 44.62 (Administrative Procedure Act), if necessary, adopt a regulation approving, modifying, or rejecting the proposed corridor.

(d) If the commissioner of transportation and public facilities approves or modifies the proposed corridor when presented under (c) of this section,

(1) the Department of Natural Resources shall promptly classify, or reclassify, and reserve any state land within the corridor for use as a corridor; and

(2) the Department of Transportation and Public Facilities shall

(A) exercise its authority under AS 19.05.040 to acquire rights-of-way across land within the corridor that is subject to the state's power of condemnation; and

(B) work with federal officials to secure reclassification and withdrawal of federal land in the corridor for reservations and rights-of-way across the federal land for use as a corridor.

(e) The requirements of AS 38.05 (Alaska Land Act) relating to classification and reclassification of land are inapplicable to actions taken under this section.

(f) In this section, "corridor" means the transportation and utility corridor required to be identified and delineated by (a) of this section.

* Sec. 2. This Act takes effect immediately under AS 01.10.070(c).

to exceed $8,500,000 for the acquisition of lands and interests therein, as provided in this title [16 USCS §§ 410gg et seq.]. Notwithstanding any other provision of law, no fees shall be charged for entrance or admission to the park.

(June 28, 1980, P. L. 96-287, Title I, § 106, 94 Stat. 600.)

HISTORY; ANCILLARY LAWS AND DIRECTIVES

Other provisions:

Authorizations effective October 1, 1980; contractual, obligatory, and payment authority provided in appropriations. Act June 28, 1980, P. L. 96-287, Title IV, § 401, 94 Stat. 602, provided: "Authorizations of moneys to be appropriated under this Act [which, among other things, enacted this section; for full classification, consult USCS Tables volumes] shall be effective on October 1, 1980. Notwithstanding any other provision of this Act, authority to enter into contracts, to incur obligations, or to make payments under this Act shall be effective only to the extent, and in such amounts, as are provided in advance in appropriation Acts.".

ALASKAN NATIONAL PARKS

CROSS REFERENCES

This subchapter is referred to in 16 USCS § 3191.

§ 410hh. Establishment of new areas

The following areas are hereby established as units of the National Park System and shall be administered by the Secretary under the laws governing the administration of such lands and under the provisions of this Act:

(1) Aniakchak National Monument, containing approximately one hundred and thirty-eight thousand acres of public lands, and Aniakchak National Preserve, containing approximately three hundred and seventy-six thousand acres of public lands, as generally depicted on map numbered ANIA-90,005, and dated October 1978. The monument and preserve shall be managed for the following purposes, among others: To maintain the caldera and its associated volcanic features and landscape, including the Aniakchak River and other lakes and streams, in their natural state; to study, interpret, and assure continuation of the natural process of biological succession; to protect habitat for, and populations of, fish and wildlife, including, but not limited to, brown/grizzly bears, moose, caribou, sea lions, seals, and other marine mammals, geese, swans, and other waterfowl and in a manner consistent with the foregoing, to interpret geological and biological processes for visitors. Subsistence uses by local residents shall be permitted in the monument where such uses are traditional in accordance with the provisions of title VIII [16 USCS §§ 3111 et seq.].

(2) Bering Land Bridge National Preserve, containing approximately two million four hundred and fifty-seven thousand acres of public land, as

generally depicted on map numbered BELA-90,005, and dated October 1978. The preserve shall be managed for the following purposes, among others: To protect and interpret examples of arctic plant communities, volcanic lava flows, ash explosions, coastal formations, and other geologic processes; to protect habitat for internationally significant populations of migratory birds; to provide for archeological and paleontological study, in cooperation with Native Alaskans, of the process of plant and animal migration, including man, between North America and the Asian Continent; to protect habitat for, and populations of, fish and wildlife including, but not limited to, marine mammals, brown/grizzly bears, moose, and wolves; subject to such reasonable regulations as the Secretary may prescribe, to continue reindeer grazing use, including necessary facilities and equipment, within the areas which on January 1, 1976, were subject to reindeer grazing permits, in accordance with sound range management practices; to protect the viability of subsistence resources; and in a manner consistent with the foregoing, to provide for outdoor recreation and environmental education activities including public access for recreational purposes to the Serpentine Hot Springs area. The Secretary shall permit the continuation of customary patterns and modes of travel during periods of adequate snow cover within a one-hundred-foot right-of-way along either side of an existing route from Deering to the Taylor Highway, subject to such reasonable regulations as the Secretary may promulgate to assure that such travel is consistent with the foregoing purposes.

(3) Cape Krusenstern National Monument, containing approximately five hundred and sixty thousand acres of public lands, as generally depicted on map numbered CAKR-90,007, and dated October 1979. The monument shall be managed for the following purposes, among others: To protect and interpret a series of archeological sites depicting every known cultural period in arctic Alaska; to provide for scientific study of the process of human population of the area from the Asian Continent; in cooperation with Native Alaskans, to preserve and interpret evidence of prehistoric and historic Native cultures; to protect habitat for seals and other marine mammals; to protect habitat for and populations of, birds, and other wildlife, and fish resources; and to protect the viability of subsistence resources. Subsistence uses by local residents shall be permitted in the monument in accordance with the provisions of title VIII [16 USCS §§ 3111 et seq.].

(4) (a) Gates of the Arctic National Park, containing approximately seven million fifty-two thousand acres of public lands, Gates of the Arctic National Preserve, containing approximately nine hundred thousand acres of Federal lands, as generally depicted on map numbered GAAR-90,011, and dated July 1980. The park and preserve shall be managed for the following purposes, among others: To maintain the wild and undeveloped character of the area, including opportunities for visitors to experience solitude, and the natural environmental integrity and scenic beauty of the mountains, forelands,

rivers, lakes, and other natural features; to provide continued opportunities, including reasonable access, for mountain climbing, mountaineering, and other wilderness recreational activities; and to protect habitat for and the populations of, fish and wildlife, including, but not limited to, caribou, grizzly bears, Dall sheep, moose, wolves, and raptorial birds. Subsistence uses by local residents shall be permitted in the park, where such uses are traditional, in accordance with the provisions of title VIII [16 USCS §§ 3111 et seq.].

16 U.S.C. 410hh(b)-(e)

(b) Congress finds that there is a need for access for surface transportation purposes across the Western (Kobuk River) unit of the Gates of the Arctic National Preserve (from the Ambler Mining District to the Alaska Pipeline Haul Road) and the Secretary shall permit such access in accordance with the provisions of this subsection.

(c) Upon the filing of an application pursuant to section 1104(b), and (c) of this Act [16 USCS § 3164(b), (c)] for a right-of-way across the Western (Kobuk River) unit of the preserve, including the Kobuk Wild and Scenic River, the Secretary shall give notice in the Federal Register of a thirty-day period for other applicants to apply for access.

(d) The Secretary and the Secretary of Transportation shall jointly prepare an environmental and economic analysis solely for the purpose of determining the most desirable route for the right-of-way and terms and conditions which may be required for the issuance of that right-of-way. This analysis shall be completed within one year and the draft thereof within nine months of the receipt of the application and shall be prepared in lieu of an environmental impact statement which would otherwise be required under section 102(2)(C) of the National Environmental Policy Act [42 USCS § 4332(2)(C)]. Such analysis shall be deemed to satisfy all requirements of that Act [42 USCS §§ 4321 et seq.] and shall not be subject to judicial review. Such environmental and economic analysis shall be prepared in accordance with the procedural requirements of section 1104(e) [16 USCS § 3164(e)]. The Secretaries in preparing the analysis shall consider the following—

(i) Alternative routes including the consideration of economically feasible and prudent alternative routes across the preserve which would result in fewer or less severe adverse impacts upon the preserve.

(ii) The environmental and social and economic impact of the right-of-way including impact upon wildlife, fish, and their habitat, and rural and traditional lifestyles including subsistence activities, and measures which should be instituted to avoid or minimize negative impacts and enhance positive impacts.

(e) Within 60 days of the completion of the environmental and economic analysis, the Secretaries shall jointly agree upon a route for issuance of the right-of-way across the preserve. Such right-of-way shall be issued in accordance with the provisions of section 1107 of this Act [16 USCS § 3167].

(5) Kenai Fjords National Park, containing approximately five hundred and sixty-seven thousand acres of public lands, as generally depicted on map numbered KEFJ-90,007, and dated October 1978. The park shall be managed for the following purposes, among others: To maintain unimpaired the scenic and environmental integrity of the Harding Icefield, its outflowing glaciers, and coastal fjords and islands in their natural state; and to protect seals, sea lions, other marine mammals, and marine and other birds and to maintain their hauling and breeding areas in their natural state, free of human activity which is disruptive to their natural processes. In a manner consistent with the foregoing, the Secretary is authorized to develop access to the Harding Icefield and to allow use of mechanized equipment on the icefield for recreation.

(6) Kobuk Valley National Park, containing approximately one million seven hundred and ten thousand acres of public lands as generally depicted on map numbered KOVA-90,009, and dated October 1979. The park shall be managed for the following purposes, among others: To maintain the environmental integrity of the natural features of the Kobuk river Valley, including the Kobuk, Salmon, and other rivers, the boreal forest, and the Great Kobuk Sand Dunes, in an undeveloped state; to protect and interpret, in cooperation with Native Alaskans, archeological sites associated with Native cultures; to protect migration routes for the Arctic caribou herd; to protect habitat for, and populations of, fish and wildlife including but not limited to caribou, moose, black and grizzly bears, wolves, and waterfowl; and to protect the viability of subsistence resources. Subsistence uses by local residents shall be permitted in the park in accordance with the provisions of title VIII [16 USCS §§ 3111 et seq.]. Except at such times when, and locations where, to do so would be inconsistent with the purposes of the park, the Secretary shall permit aircraft to continue to land at sites in the upper Salmon River watershed.

(7) (a) Lake Clark National Park, containing approximately two million four hundred thirty-nine thousand acres of public lands, and Lake Clark National Preserve, containing approximately one million two hundred and fourteen thousand acres of public lands, as generally depicted on map numbered LACL-90,008, and dated October 1978. The park and preserve shall be managed for the following purposes, among others: To protect the watershed necessary for perpetuation of the red salmon fishery in Bristol Bay; to maintain unimpaired the scenic beauty and quality of portions of the Alaska Range and the Aleutian Range, including active volcanoes, glaciers, wild rivers, lakes, waterfalls, and alpine meadows in their natural state; and to protect habitat for and populations of fish and wildlife including but not limited to caribou, Dall sheep, brown/grizzly bears, bald eagles, and peregrine falcons.

STATE OF ALASKA

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

TONY KNOWLES, GOVERNOR

☑ 794 UNIVERSITY AVENUE, SUITE 200
FAIRBANKS, ALASKA 99709-3645
PHONE: (907) 451-5000
FAX: 451-5050

☐ GEOLOGIC MATERIALS CENTER
P.O. BOX 772116
EAGLE RIVER, ALASKA 99577-2116
PHONE: (907) 696-0079
FAX: 696-0078

☐ 400 WILLOUGHBY AVENUE, 3RD FLOOR
JUNEAU, ALASKA 99801
PHONE: (907) 465-2520

January 30, 1995

Representative Jeanette James
State of Alaska House of Representatives
State Capitol, Room 501
Juneau, AK 99801-1182

Dear Representative James:

In response to a request from Mr. Walt Wilcox of your office, we are forwarding to you two of our reports which we hope will be of use to you: Information Circular 33; "Alaska's High Rank Coals" and Special Report 37, "Description of Alaska's Coal Resources".

Please do not hesitate to contact us if you require additional information on Alaska's resources.

Sincerely,

Thomas E. Smith
Director & State Geologist

:keb

cc: Resource Information Section

ALASKA'S HIGH-RANK COALS

INFORMATION CIRCULAR 33

State of Alaska
DIVISION OF GEOLOGICAL &
GEOPHYSICAL SURVEYS

ALASKA'S HIGH-RANK COALS

A summary of high-rank coal resources in Alaska and their potential for mining and development.

First Edition 1990
Revised Edition 1993

Department of Natural Resources
DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS
Fairbanks, Alaska

Cover photo: *North limb of Wishbone Hill syncline, Matanuska Valley. (See fig. 8, p. 7.)*

STATE OF ALASKA
Walter J. Hickel, *Governor*

DEPARTMENT OF NATURAL RESOURCES
Glenn A. Olds, *Commissioner*

DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS
Thomas E. Smith, *State Geologist*

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3601 C Street, Suite 200
Anchorage, Alaska 99510

This publication, produced and released by the Division of Geological & Geophysical Surveys, and printed in Delta Junction, Alaska, by Dragon Press at a cost of $2.66 per copy. Publication is required by Alaska Statute 41, "to determine the potential of Alaskan land for production of metals, minerals, fuels, and geothermal resources; the location and supplies of groundwater and construction materials; the potential geologic hazards to buildings, roads, bridges, and other installations and structures; and shall conduct such other surveys and investigations as will advance knowledge of the geology of Alaska."

FOREWORD

Although current coal production is limited to subbituminous coals, Alaska produced high rank coals from the Matanuska field until 1968. Plans are again under way for production from the Matanuska field. Deadfall syncline coal, being in close proximity to the Bering Sea, is another candidate for development and is receiving renewed attention. For example, seam K3 of this field is of high volatile A bituminous rank and has a maximum thickness of 17 feet, with an average ash content of 9 percent and over 10 feet of this seam averages less than 4 percent ash. Other exposures along Kukpowruk, Kokolik, and Utukok rivers are of similar high quality.

The low volatile bituminous coal of the Bering River field has been well explored. Some seams of this field have unusually low ash content and could be washed to produce clean coal containing less than 0.5 percent ash for special utilization purpose. Coals of the Alaska Peninsula, near Chignik, have been mined in the past for use in fish canneries. Alaska has extensive high rank coal deposits which await development.

P.D. Rao
Associate Director
Mineral Industry Research Laboratory

STATE AGENCIES INVOLVED IN COAL EXPLORATION, DEVELOPMENT AND MARKETING

• OFFICE OF INTERNATIONAL TRADE (OIT)
Frontier Building
3601 C St., 7th Floor
Anchorage, Alaska 99503
(907) 562-2728
Robert Poe, *Director*

Promotes trade and export of Alaska products, including mineral and fuel resources, to worldwide markets.

• DEPARTMENT OF NATURAL RESOURCES (DNR)
400 Willoughby Avenue, 5th Floor
Juneau, Alaska 99801
(907) 465-2400
Rod Swope, *Commissioner*

Chief agency that manages and administers Alaska's state lands.

Division of Mining (DOM)
Frontier Building
3601 C St., Suite 800
P.O. Box 107016
Anchorage, Alaska 99510
(907) 762-2163
Gerald L. Gallagher, *Director*

Chief agency for regulation and management of coal mining on State land in Alaska. Leases coal land and issues coal-prospecting and coal-exploration permits. Administers the Alaska Surface Mining Control and Reclamation Act (ASMCRA), which includes permitting and inspection of coal-mining activity and reclamation of abandoned mines.

Division of Geological and Geophysical Surveys (DGGS)
3700 Airport Way
Fairbanks, Alaska 99709
(907) 451-2760
Robert B. Forbes, *Director and State Geologist*

Chief agency conducting field investigations, exploration, and research relating to Alaska's coals. Determines the coal resources and development potential of Alaska's lands. Provides information used to determine state land designations (AAC 85.010) for coal-lease purposes in areas of high to moderate coal-development potential. Serves as liaison with industry, Native corporations, and other state and federal agencies, and lends technical advice in matters pertaining to Alaska's coal. Serves as repository for information on Alaska's coal. Publishes a wide range of reports containing results of coal investigations.

• DEPARTMENT OF COMMERCE AND ECONOMIC DEVELOPMENT (DCED)
State Office Building, 9th Floor
P.O. Box D
Juneau, Alaska 99811
(907) 465-2500
Larry Merculieff, *Commissioner*

Promotes economic development in Alaska.

Division of Business Development (DBD)
State Office Building, 9th Floor
P.O. Box D
Juneau, Alaska 99811
(907) 465-2094
James M. Parsons, *Director*
Tom Lawson, *Deputy Director*

Chief advocacy agency in state government for the mining industry. Provides liaison between state government and the private sector. Researches and publishes economic data on Alaska's mining industry.

• UNIVERSITY OF ALASKA
Mineral Industry Research Laboratory (MIRL)
210 O'Neill Resources Building
Fairbanks, Alaska 99775
(907) 474-7135 or 474-7136
Russell Ostermann, *Acting Director*
P.D. Rao, *Associate Director*

Conducts applied and basic research on the location, development, and use of Alaska's coal resources. Specializes in the mineralogical, chemical, and petrographic characterization of Alaska's coals and their preparation. Publishes reports and general information concerning coal mining and utilization in Alaska.

CONTENTS

FIGURES

TABLES

CONVERSION FACTORS

To convert	to	multiply by
acres	hectares	0.4047
feet	meters	0.3048
meters	feet	3.281
miles	kilometers	1.609
kilometers	miles	0.6214
square miles	square kilometers	2.590
tons*	metric tons	0.9072
Btu/lb	Kcal/Kg	0.5556

*All tonnages reported here are in short tons (2,000 lb).

ALASKA'S HIGH-RANK COALS

INTRODUCTION

It is estimated that as much as 55 percent of Alaska's abundant coal resources--approximately 3 trillion tons--is high-rank (bituminous) coal (fig. 1). Bituminous coal deposits are found not only on Alaska's North Slope, but also in the Matanuska, Bering River, Chignik, and Herendeen Bay coalfields (fig. 2). Measured resources are summarized in figure 3; identified and hypothetical resources are listed in table 1. Significant potential exists for large, yet-undiscovered deposits of high-rank coal.

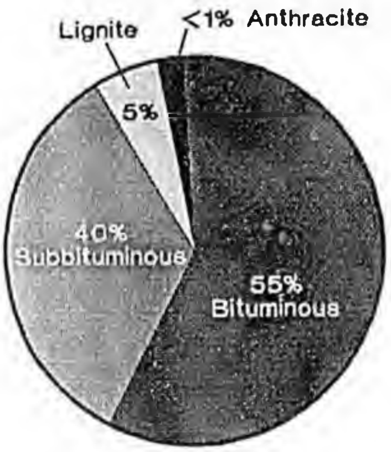

Figure 1. Alaska's coal resources divided by rank.

Early studies of Alaska's high-rank coals were directed at determining suitability for blacksmithing use or for steamship fuel. Investigations now are directed toward developing a market for Alaska coals in Pacific Rim nations, as well as for local heat and power generation (table 2).

Bituminous coals formed in Alaska during the Cretaceous Period (65-140 million years ago) from heat and pressure created by structural deformation of coal-bearing rocks. Most bituminous Alaska coals have a low sulfur content (less than 1 percent) and exhibit coking characteristics that range from poor to excellent. Potential coking and metallurgical-grade coals are found in the Chickaloon district, Matanuska coalfield; Western Arctic region, especially at Kukpowruk River; Bering River coalfield; Chignik and Herendeen Bay coalfields, Alaska Peninsula; Lisburne coalfield; and the Lower Yukon basin-Nulato coalfield. More than 7 million tons of bituminous coal has been mined in Alaska, most of it from the Matanuska coalfield before 1968.

Some of Alaska's coal resources (less than 1 percent) are anthracitic coals--semianthracite, anthracite, and meta-anthracite. Deposits of Tertiary age are found in eastern parts of the Matanuska and Bering River coalfields, and Mississippian-age deposits are found in northern Alaska. High-rank coal has long been known to exist in Mississippian rocks, but mineable resources are small and therefore not discussed here.

Table 1. *Estimate of identified and hypothetical resources of Alaska's high-rank coals (in millions of tons).*

	Identified	Hypothetical
Deadfall syncline	500	5,000
Cape Beaufort	390	1,700
Kukpowruk River	275	1,200
Chignik	230	1,500
Bering River	160	3,500
Herendeen Bay	130	1,500
Wishbone Hill	120	350
Chickaloon	25	100
Anthracite Ridge	4.5	50
TOTALS	1,834.5	14,900

Table 2. *Current high-rank coal development projects in Alaska.*

Company	Project and location
Union Pacific Resources/ Idemitsu Kosan	Wishbone Hill, Matanuska Field
Arctic Slope Regional Corporation	Western Arctic Coal Project
Morgan Coal Company	Kukpowruk River
Chugach Alaska Corporation	Korea-Alaska Development Corporation Project, Bering River Field
Bristol Bay Native Corporation	Chignik Field, Alaska Peninsula

ACKNOWLEDGMENTS

The Alaska Division of Geological & Geophysical Surveys (DGGS) thanks the Office of International Trade for funding, which initiated this study. The information was collected by R.D. Merritt, formerly of DGGS. Coalfield tables include data compiled by P.D. Rao and published by the University of Alaska Fairbanks, Mineral Industry Research Laboratory (1986). The design and production was by G.M. Laird (DGGS). The agency also wishes to thank the following individuals whose efforts made this brochure possible. We acknowledge technical reviews by John F.M. Sims, Usibelli Coal Mine, Inc., and Gilbert R. Eakins, geologist (retired) DGGS. The report was edited by C.L. Daniels and A.F. Seward (DGGS). Cartography by Nori Bowman and Teresa Imm. Typesetting by Roberta Mann, and paste-up by A-L. Schell.

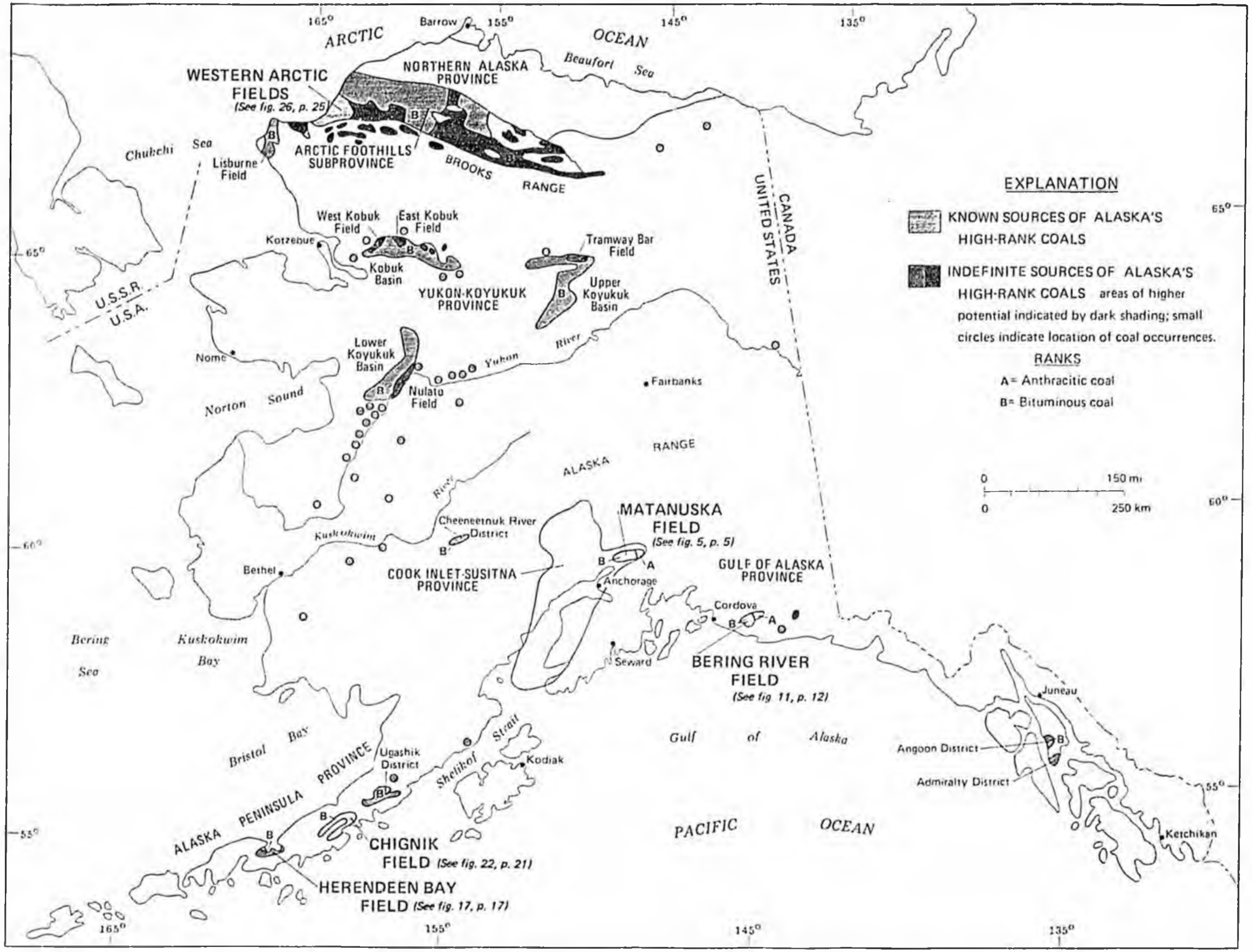

Figure 2. Map showing the general distribution of Alaska's high-rank coal deposits (modified from Merritt and Hawley, 1986).

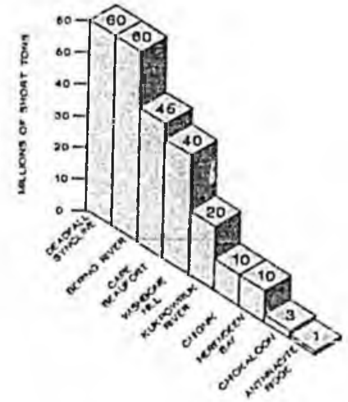

Figure 3. Estimated measured resources of Alaskan high-rank coals.

MATANUSKA COALFIELD

DESCRIPTION

LOCATION

The Matanuska coalfield in south-central Alaska is an eastern extension of the Cook Inlet-Susitna coal province and underlies most of the Matanuska Valley (fig. 2). Its western margin is 45 mi northeast of Anchorage.

The Matanuska field contains five coal districts (fig. 4). The Wishbone Hill district is located about 10 mi northeast of Palmer; its chief coal-bearing feature is the Wishbone Hill syncline. The Young Creek, Castle Mountain, and Chickaloon districts underlie the central Matanuska Valley. The Chickaloon district is centered around the old mining camp at Chickaloon, about 30 mi northeast of Palmer. The Anthracite Ridge district is situated at the east end of the Matanuska Valley about 12 mi east of Chickaloon.

AREA

The Wishbone Hill district occupies about 20 mi² between Moose and Granite Creeks. The Chickaloon district covers a 10-mi² area on lower Chickaloon River and Coal Creek. The Anthracite Ridge district includes a 20-mi² area that extends south from Anthracite Ridge to the Matanuska River.

GEOLOGY

Tertiary coal deposits of the Matanuska field occur within Paleocene-lower Eocene rocks of the Chickaloon Formation. The upper 1,400 ft of this unit contains several series (or groups) of coal beds within layers of claystone, siltstone, sandstone, and conglomerate (fig. 5). Deposition occurred predominantly in a meandering fluvial to paludal paleoenvironment. Stratigraphic structure varies from moderately complex at the west margin of the Matanuska field to complex at its east margin. Beds range in dip from 7° to overturned; typically they dip from 20° to 65°.

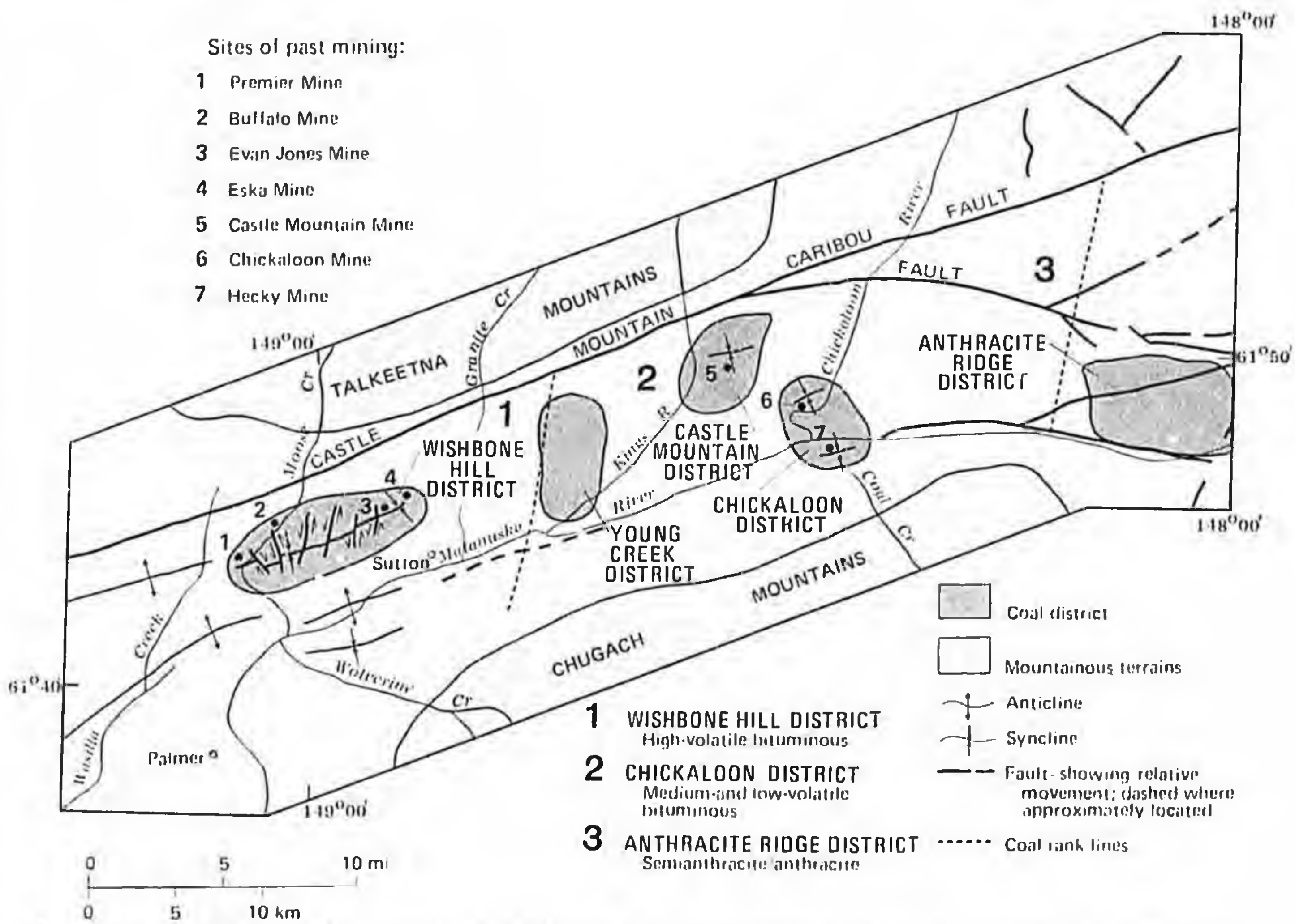

Figure 4. Major districts of the Matanuska coalfield, Matanuska Valley, south-central Alaska (modified from Merritt, 1986).

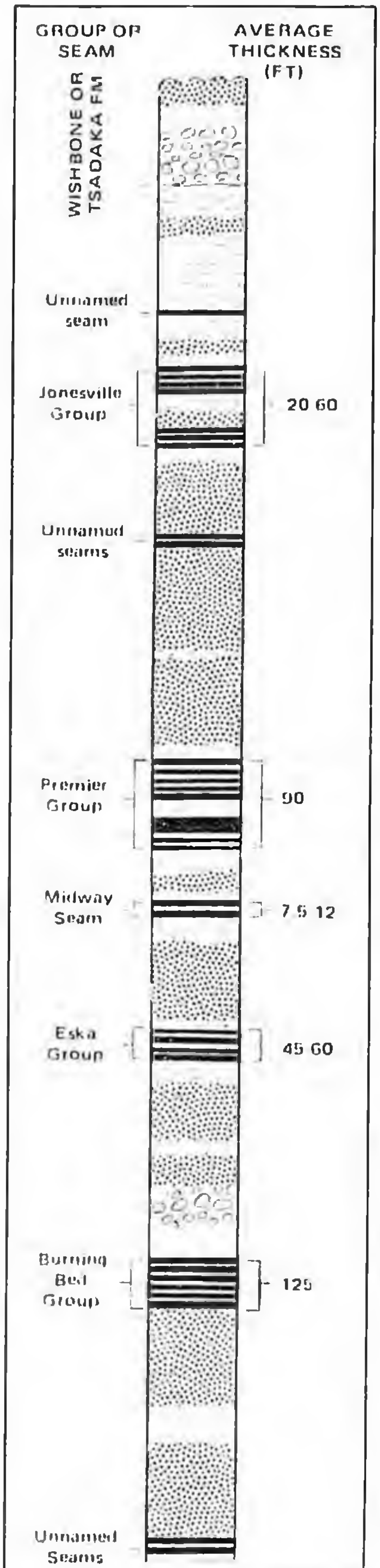

Figure 5. Generalized stratigraphic section of the upper Chickaloon Formation, western Wishbone Hill district, Matanuska field (after Hawley and others, 1984).

The main structural feature of the Wishbone Hill district is the northeast-trending Wishbone Hill syncline, which has moderately dipping limbs and is cut by several transverse faults (fig. 6). The structure of the Chickaloon district is dominantly synclinal, but complicated by faulting and intrusion of dikes and sills. The Anthracite Ridge district also encompasses a synclinal basin that has been sharply folded and faulted and intruded by igneous dikes and sills. Coal rank and structural complexity increase progressively to the east.

MINING HISTORY

Coal was mined in the Matanuska field from 1914 to 1968 (fig. 7). When the Alaska Railroad was completed to the Matanuska field in 1916, mining expanded to the Moose Creek area of the Wishbone Hill district. Early exploration and development in the Matanuska Valley was carried out by the U.S. Government; the Navy searched for steaming coal, and the Alaska Engineering Commission sought coal supplies for railroad fuel.

Figure 4 locates historical mining operations in the Matanuska field: the Premier Mine, which operated from 1925 to 1971; the Buffalo Mine, 1942-45; the Evan Jones Mine, 1920-65; the Eska Mine, 1917-46; the Castle Mountain Mine, 1958-60; the Chickaloon Mine, 1917-22; and Hecky or Coal Creek Mine, 1925-30. Total past production was about 7.5 million tons, mostly from stripping and underground workings of the Evan Jones Mine at Wishbone Hill (fig. 8). Mining ceased in the Matanuska field in 1968 when Cook Inlet natural gas supplanted coal use in the Anchorage area. Minor production at the Premier Mine continued to provide coal for local needs until 1982. Recent exploration and mine-feasibility studies have been completed by Union Pacific Resources (figs. 9 and 10).

ACCESS

The Matanuska field is favorably located with respect to rail and road links, and hence is not a 'green-field' energy development. The Glenn Highway passes along its southern edge, and the western part of the field is served by the Alaska Railroad. No major construction of transportation facilities would be required to resume coal-mining operations in the Matanuska field.

COAL RESOURCES

Wishbone Hill district

Bituminous coal beds to 23 ft thick occur in the upper 1,400 ft of the Chickaloon Formation. Most beds are greater than 3.5 ft thick. Total estimated resources (to a depth of 2,000 ft) are:

Measured	40 million tons
Identified	120 million tons
Hypothetical	350 million tons

Chickaloon district

Bituminous coal beds up to 14 ft thick yield two main deposits: at Chickaloon north of the Matanuska River and at Coal Creek south of the Matanuska River. Total estimated resources (to a depth of 2,000 ft) are:

Measured	3 million tons
Identified	25 million tons
Hypothetical	100 million tons

Anthracite Ridge district

A 20-acre tract in the Purinton Creek area contains an estimated 1 million tons of anthracite and semianthracite. Although coal beds are usually less than 5 to 10 ft thick, beds 24 and 34 ft thick have been measured at two exposures. Total estimated resources (to a depth of 2,000 ft) are:

Measured	1 million tons
Identified	4.5 million tons
Hypothetical	50 million tons

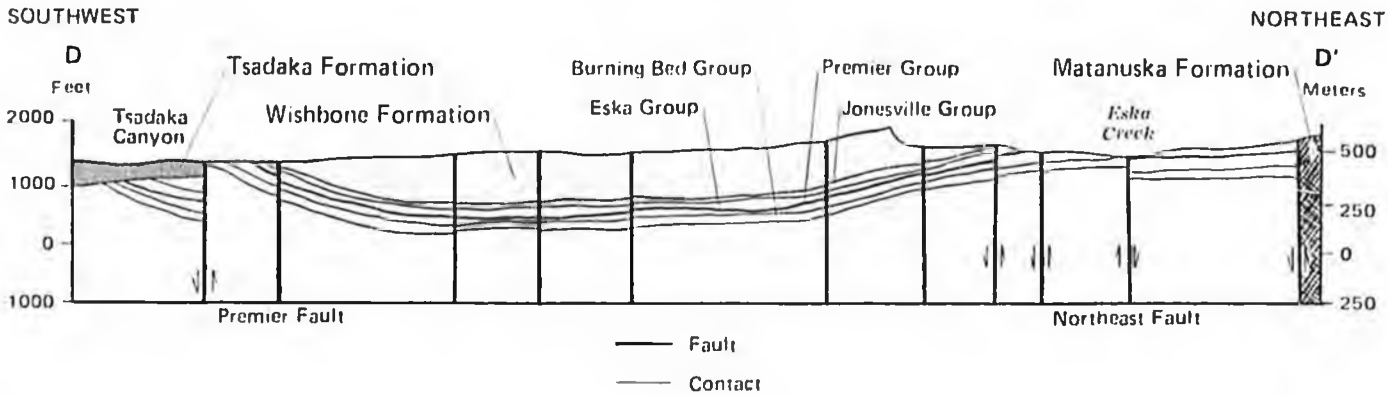

Figure 6. Longitudinal cross section of the Wishbone Hill syncline (from Gerner, 1987).

Figure 7. Coal production in Matanuska field, 1915-1970 (from Merritt and Belowich, 1984).

LAND STATUS

Land in the Matanuska coalfield is state-owned.

Figure 8. Highwall face at Evan Jones surface mine, north limb of Wishbone Hill syncline, Matanuska Valley. (Photo by G.R. Eakins, 1981.)

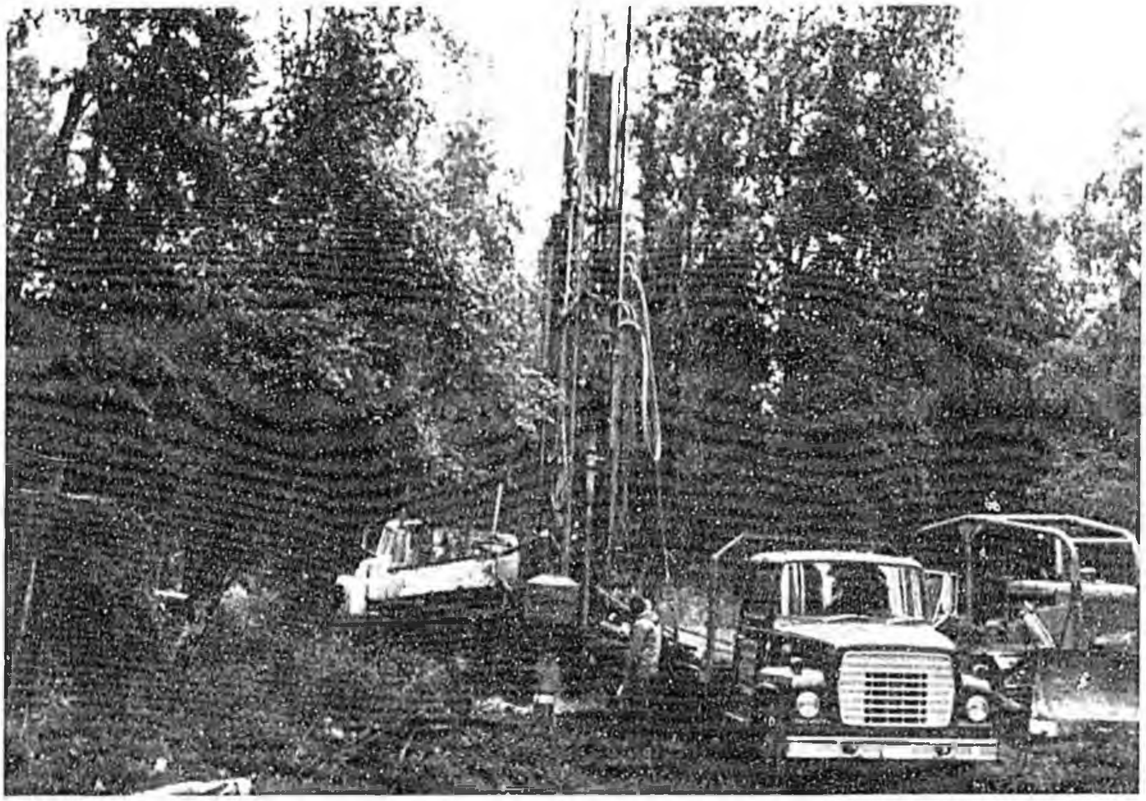

Figure 9. Drilling for coal at the Wishbone Hill project of Union Pacific Resources. (Photo by R.D. Merritt, 1983.)

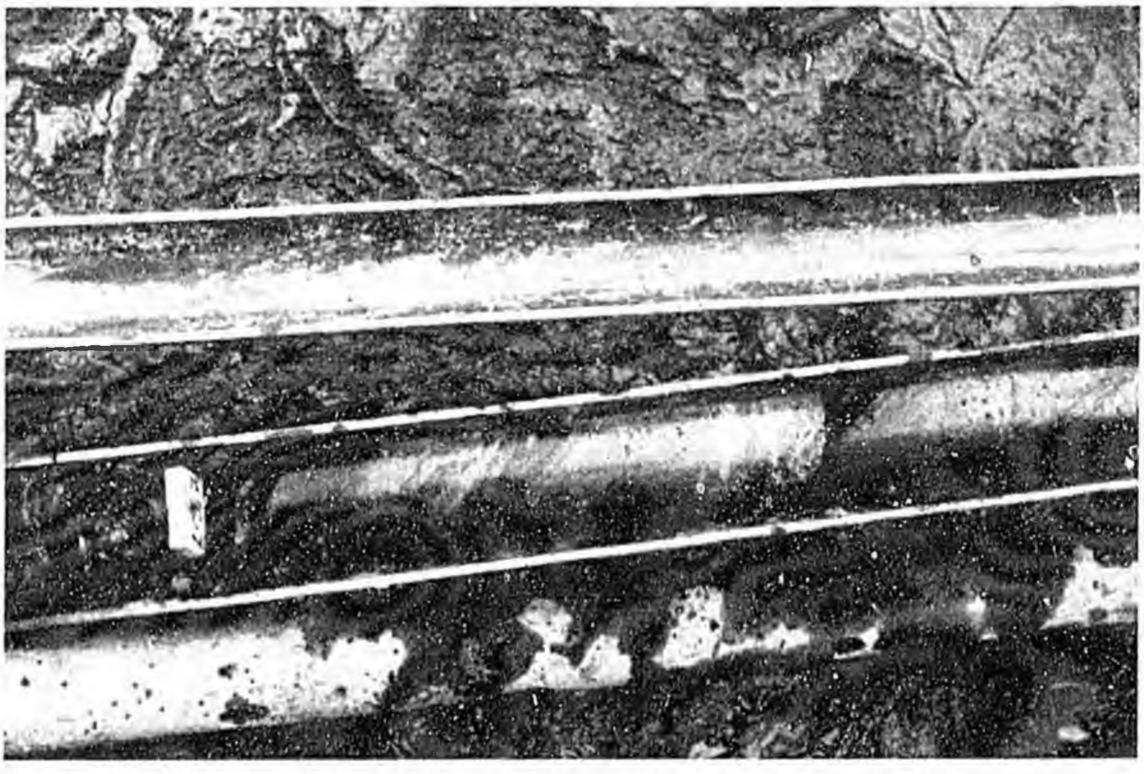

Figure 10. Drill core from the Wishbone Hill project of Union Pacific Resources. (Photo by R.D. Merritt, 1983.)

Matanuska Coalfield Data
WISHBONE HILL

COAL QUALITY

Rank: hvBb

Heating content: Range 10,400-13,200 Btu/lb

Proximate analysis (range in %):

Moisture	3-9	Fixed carbon	38-51
Volatile matter	32-45	Ash	4-24

Ultimate analysis (range in %):

Carbon	50-70	Oxygen	10-17
Hydrogen	4.5-5.5	Sulfur	0.2-0.6
Nitrogen	1.0-1.4	Ash	4-24

Major-oxide composition of ash (avg. in %):

SiO_2	56.81	SO_3	1.11
Al_2O_3	28.94	P_2O_5	0.79
Fe_2O_3	2.97	Na_2O	0.70
CaO	2.36	SrO	0.18
K_2O	1.86	BaO	0.18
TiO_2	1.56	MnO	0.02
MgO	1.12	Undet.	1.40

Trace elements in coal ash (avg. in ppm):

Antimony	2	Lithium	334
Arsenic	8	Molybdenum	3
Beryllium	0.5	Neodymium	4
Boron	77	Nickel	8
Bromine	2	Niobium	7
Cadmium	1	Praseodymium	4
Cerium	19	Rubidium	9
Cesium	3	Samarium	4
Chlorine	8	Scandium	19
Chromium	14	Selenium	2
Cobalt	16	Tellurium	1
Copper	27	Thorium	6
Europium	0.5	Tin	3
Fluorine	230	Uranium	4
Gallium	22	Vanadium	90
Germanium	1.1	Yttrium	22
Iodine	2	Zinc	14
Lanthanum	19	Zirconium	74
Lead	6		

Fusibility of ash (°F):

Initial deformation	2380
Softening temperature (H=W)	2600
Hemispherical temperature (H= W)	2640
Fluid temperature	2700

Free-swelling index: 0-2

Hardgrove grindability index: 47

Coking potential: Poor to fair strongly coking; possible metallurgical.

COAL PETROLOGY

Avg. composition, volume, mineral-matter-free basis, in %:

Vitrinite	78.0
Pseudovitrinite	0.1
Gelinite	1.1
Corpocollinite	0.2
Vitrodetrinite	12.8
Total vitrinite	92.2
Fusinite	0.3
Semifusinite	0.2
Sclerotinite	0.5
Macrinite	0.1
Inertodetrinite	1.2
Total inertinite	2.3
Cutinite	0.5
Sporinite	0.1
Resinite	3.2
Suberinite	0.1
Liptodetrinite	1.6
Total liptinite	5.5

Mean-maximum vitrinite reflectance (Ro_{max}, %): 0.5-0.6

CHICKALOON

COAL QUALITY

Rank: mvb-lvb

Heating content: Range 11,960-14,400 Btu/lb

Proximate analysis (range in %):

Moisture	1-5	Fixed carbon	60-72
Volatile matter	14-24	Ash	5-18

Ultimate analysis (range in %):

Carbon	65-77	Oxygen	6-10
Hydrogen	4.2-5.2	Sulfur	0.2-0.7
Nitrogen	1.3-1.7	Ash	5-18

Major-oxide composition of ash (avg. in %):

SiO_2	53.92	SO_3	1.13
Al_2O_3	29.73	P_2O_5	1.46
Fe_2O_3	4.34	Na_2O	0.68
CaO	2.63	SrO	0.22
K_2O	1.72	BaO	0.21
TiO_2	1.32	MnO	0.04
MgO	1.52	Undet.	1.08

Trace elements in coal ash (avg. in ppm):

Antimony	1	Lithium	222
Arsenic	4	Molybdenum	8
Beryllium	0.9	Neodymium	7
Boron	66	Nickel	9
Bromine	4	Niobium	11
Cadmium	2	Praseodymium	4
Cerium	36	Rubidium	28
Cesium	4	Samarium	5
Chlorine	32	Scandium	22
Chromium	18	Selenium	5
Cobalt	6	Tellurium	1
Copper	40	Thorium	10
Europium	0.9	Tin	8
Fluorine	425	Uranium	5
Gallium	18	Vanadium	85
Germanium	1.7	Yttrium	18
Iodine	5	Zinc	30
Lanthanum	27	Zirconium	80
Lead	14		

Fusibility of ash (°F):

Initial deformation	2360
Softening temperature (H=W)	2430
Hemispherical temperature (H= W)	2510
Fluid temperature	2560

Free-swelling index: 0-8

Hardgrove grindability index: 72

Coking potential: Noncoking to strongly coking; possible metallurgical.

COAL PETROLOGY

Avg. composition, volume, mineral-matter-free basis, in %:

Vitrinite	80.5
Pseudovitrinite	0.5
Gelinite	0.0
Corpocollinite	0.3
Vitrodetrinite	15.8
Total vitrinite	97.1
Fusinite	0.3
Semifusinite	0.3
Sclerotinite	0.2
Macrinite	0.1
Inertodetrinite	0.4
Total inertinite	1.3
Cutinite	0.0
Sporinite	0.0
Resinite	0.4
Suberinite	0.5
Liptodetrinite	0.7
Total liptinite	1.6

Mean-maximum vitrinite reflectance (Ro_{max}, %): 1.1-2.1

ANTHRACITE RIDGE

COAL QUALITY

Rank: sa-an

Heating content: Range 10,720-14,000 Btu/lb

Proximate analysis (range in %):

Moisture	3-9	Fixed carbon	65-81
Volatile matter	7-11	Ash	6-17

Ultimate analysis (range in %):

Carbon	66-75	Oxygen	6-15
Hydrogen	2.8-5.6	Sulfur	0.2-0.7
Nitrogen	1.2-1.7	Ash	6-17

Major-oxide composition of ash (avg. in %):

SiO_2	49.26	SO_3	0.97
Al_2O_3	29.95	P_2O_5	3.24
Fe_2O_3	4.46	Na_2O	0.71
CaO	4.75	SrO	0.31
K_2O	1.53	BaO	0.42
TiO_2	1.53	MnO	0.02
MgO	1.54	Undet.	1.31

Trace elements in coal ash (avg. in ppm):

Antimony	1	Lithium	84
Arsenic	7	Molybdenum	6
Beryllium	1.0	Neodymium	34
Boron	85	Nickel	58
Bromine	52	Niobium	7
Cadmium	2	Praseodymium	4
Cerium	35	Rubidium	12
Cesium	4	Samarium	3
Chlorine	66	Scandium	26
Chromium	9	Selenium	2
Cobalt	10	Tellurium	2
Copper	22	Thorium	7
Europium	0.5	Tin	2
Fluorine	361	Uranium	4
Gallium	17	Vanadium	79
Germanium	1.1	Yttrium	17
Iodine	3	Zinc	17
Lanthanum	22	Zirconium	61
Lead	7		

Fusibility of ash (°F):

Initial deformation	2490
Softening temperature (H=W)	2560
Hemispherical temperature (H= W)	2570
Fluid temperature	2590

Free-swelling index: 0-2

Hardgrove grindability index: --

Coking potential: Some coking properties in bituminous coals only.

COAL PETROLOGY

Avg. composition, volume, mineral-matter-free basis, in %:

Vitrinite	84.5
Pseudovitrinite	0.0
Gelinite	0.0
Corpocollinite	0.2
Vitrodetrinite	11.8
Total vitrinite	96.5
Fusinite	0.2
Semifusinite	0.1
Sclerotinite	0.4
Macrinite	0.0
Inertodetrinite	0.2
Total inertinite	0.9
Cutinite	0.1
Sporinite	0.0
Resinite	0.8
Suberinite	0.4
Liptodetrinite	1.3
Total liptinite	2.6

Mean-maximum vitrinite reflectance (Ro_{max}, %): 2.0-5.0

BERING RIVER COALFIELD

DESCRIPTION

LOCATION

The Bering River coalfield is located in south-central Alaska and constitutes the most important resource of the Gulf of Alaska coal province (fig. 11). The field is 12 mi northeast of Katalla, 50 mi east of Cordova, and 200 mi east of Anchorage.

AREA

The belt of coal-bearing rocks extends 20 mi northeast from the eastern shore of Bering Lake and disappears under ice fields in the Chugach Range. The Bering River coalfield width varies from 2 to 6 mi and covers an estimated area of 80 mi² (fig. 11).

GEOLOGY

The coalfield is defined by the outcrop of the Kushtaka Formation, a 2,000-ft-thick arkosic Tertiary (Eocene-early Miocene) sequence that also includes feldspathic sandstones, siltstones, shales, and coal beds (fig. 12; table 3). Its geologic structure

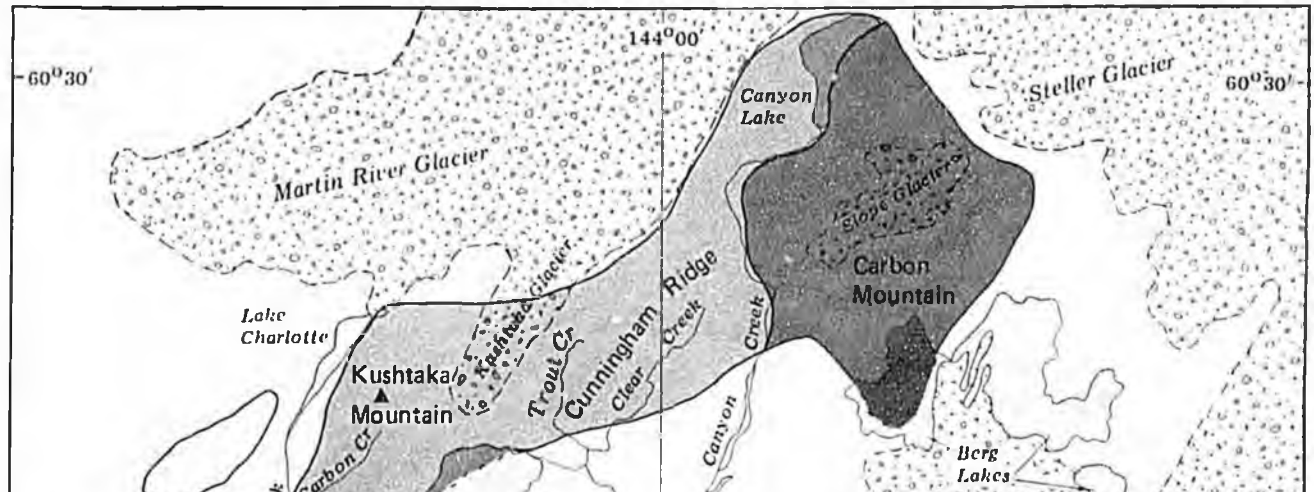

Figure 11. Generalized outcrop extent of the Kushtaka Formation of the Bering River coalfield showing the eastward gradation in coal rank (from Merritt, 1986).

Table 3. *Generalized stratigraphy in the Bering River coalfield (after Barnes, 1951).*

Age	Formation	Lithology	Sedimentation
Quaternary		fresh-water, glacial, marine origin sediments	fresh-water, glacial, marine
Tertiary or Post-Tertiary		diabase, basalt, dikes	
Tertiary	Tokun Formation	sandstone, sandy shale, shale	marine origin
	Kushtaka Formation	arkose, sandstone, sandy shale, shale, coal, coaly shale	fresh-water
	Stillwater Formation	shale, sandstone, sandy shale	partial saline partial fresh-water
	Katalla Formation	conglomerate, sandstone, shale, nodular shale, inter-bedded glauconitic sand	marine origin
Tertiary or Pre-Tertiary		graywacke, slate, igneous rock	

is complex; average dip of beds is 40° (fig. 13). Coals occur in a highly compressed series of isoclinal, chevron-like folds, incorporated into an imbrication or pinching-and-swelling selvage along one of numerous bedding-plane faults. The beds are thinned by tectonic lensing to form 'schlieren,' and thickened at the axes of folds (figs. 14 and 15). Coal rank increases with intensity of deformation to the east.

MINING HISTORY

The Bering River field was discovered in 1896. Extensive exploration and testing of the coals were conducted during the early 1900s. Despite the identification of numerous surface and underground prospects, no commercial mines have been developed. The total amount of coal produced to date is estimated at only a few thousand tons.

In recent years, the Chugach Alaska Corporation, in association with the Korea-Alaska Development Corporation, has been studying the

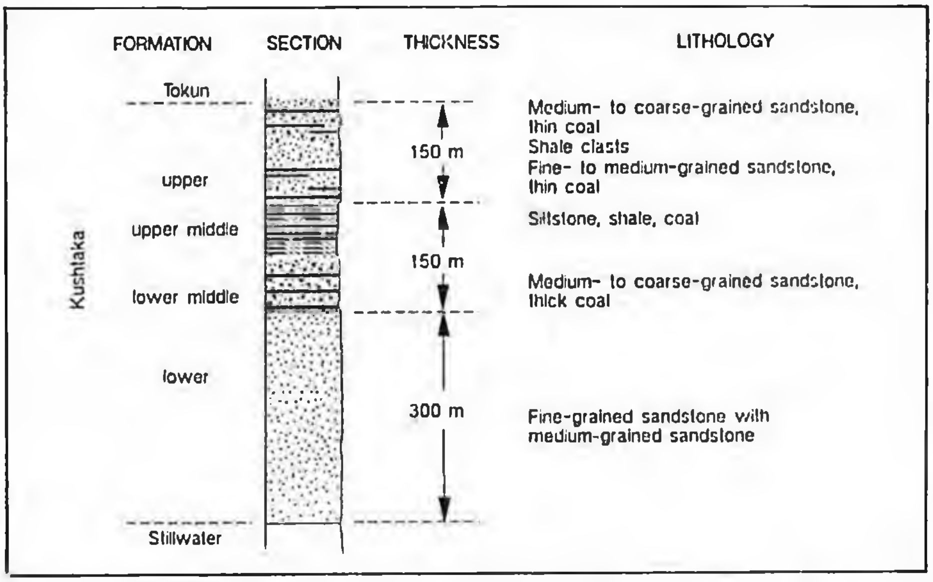

Figure 12. Stratigraphy of the Kushtaka Formation (after Smith and Rao, 1987).

feasibility of developing a coal mine in the Bering River field to produce coal for export. Thousands of feet of core drilling have been completed in the last few years (fig. 16). A tentative mine plan proposes a combination of open-pit and underground mining methods.

ACCESS

The Bering River field is about 25 mi from tidewater. It would be considered a 'green-field' energy project, since it has no infrastructure or overland transportation access system. Such a system would likely consist of a conveyor or aerial tramway to transport coal from the mine to a storage facility at a marine terminal on the southeast tip of Kanak Island, where it would be loaded on ships for export. An access road would connect the mine-site facilities with the road to Cordova.

COAL RESOURCES

Coal resources are concentrated in four main areas: Carbon Creek, Trout Creek, Clear Creek/Cunningham Ridge, and Carbon Mountain. The Carbon Creek area is the most promising in size and physical condition of beds. At least 20 coal beds ranging from 5 to 10 ft thick have been confirmed. Lenses 30 to 60 ft thick occur locally.

Resources are summarized as follows (with overburden depths of 0 to 3,000 ft):

Measured	60 million tons
Identified	160 million tons
Hypothetical	3,500 million tons

LAND STATUS

Lands in the Bering River coalfield are owned by Chugach Alaska Corporation.

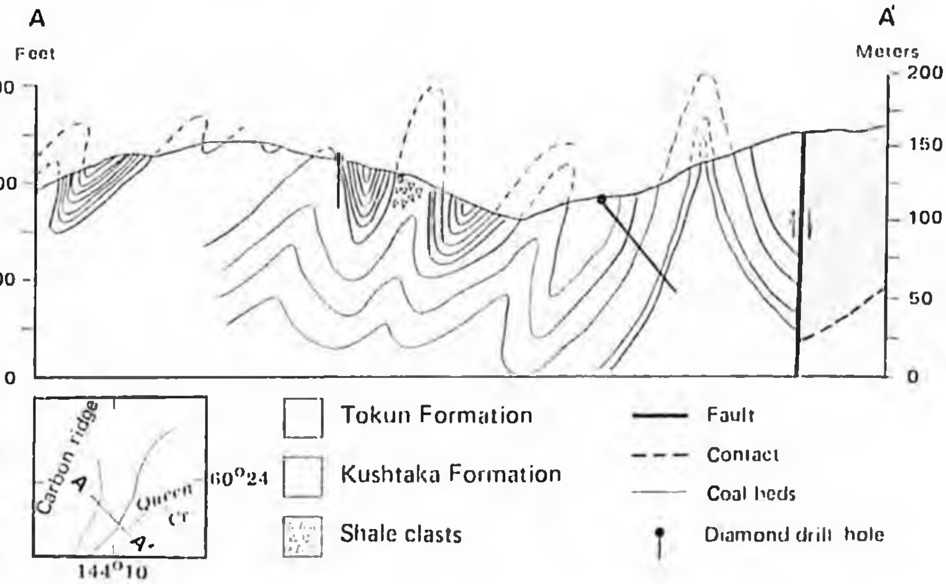

Figure 13. Cross section of the Carbon Ridge area (modified from Smith and Rao, 1987).

Figure 14. The 'Queen Vein,' a 28-foot thick coal seam of the Bering River field. (Photo by R.B. Sanders, 1973.)

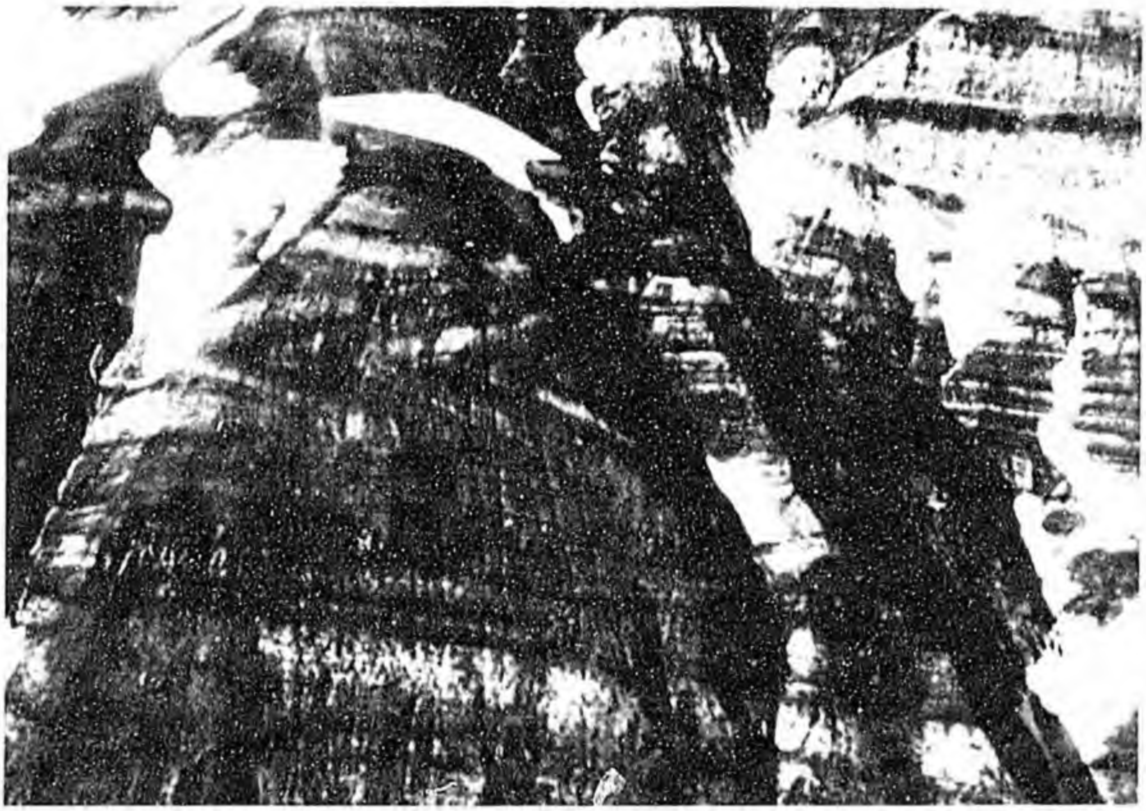

Figure 15. Folding in coal beds in the Carbon Mountain area, Bering River field. (Photo by R.B. Sanders, 1973.)

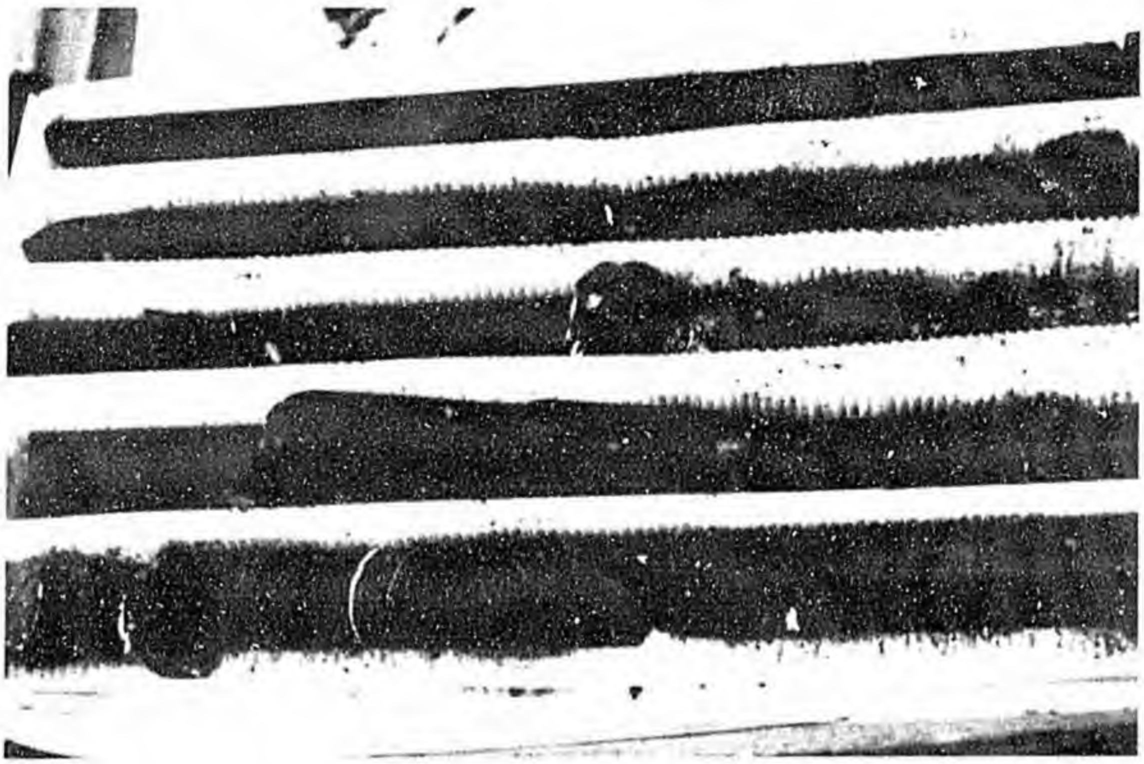

Figure 16. Coal core from Bering Development Corporation's drilling project in the Bering River field, 1984. (Photo courtesy of Bering Development Corporation.)

Bering River Coalfield Data

COAL QUALITY

Rank: Ranges from low-volatile bituminous in the western part of the field to semianthracite and anthracite in the eastern part.

Heating content:	Range	11,000-15,000 Btu/lb
	Average	14,000 Btu/lb

Proximate analysis:	Range (%)	Average (%)
Moisture	0.01-1.80	0.52
Volatile matter	2.67-16.15	12.45
Fixed carbon	63.51-85.03	78.55
Ash	1.14-22.46	8.48

Ultimate analysis:

Carbon	68.02-89.14	82.14
Hydrogen	0.76-4.49	3.82
Nitrogen	0.81-1.66	1.31
Oxygen	1.40-4.17	3.00
Sulfur	0.21-4.49	1.25
Ash	1.14-22.46	8.48

Major-oxide composition of ash (avg. in %):

SiO_2	40.03	MgO	1.78
Al_2O_3	20.82	P_2O_5	1.84
Fe_2O_3	14.26	Na_2O	1.00
CaO	7.02	MnO	0.10
K_2O	1.29	Undet.	10.86
TiO_2	1.00		

Trace elements in coal ash (avg. in ppm).

Barium	1,850	Nickel	273
Beryllium	10.5	Strontium	4,282
Chromium	246	Vanadium	198
Cobalt	86	Zinc	677
Copper	166	Zirconium	232

Free-swelling index: 0-2.5

Coking potential: It is questionable whether the low-volatile bituminous coals possess coking properties, but it is expected that a good coke can be produced by blending the low-volatile bituminous coals with other high-volatile bituminous coals.

Metallurgical potential: Possible source of high-grade metallurgical coal.

COAL PETROLOGY

Maceral Composition

Because of the high rank of the coals of the Bering River field, maceral analyses are of little benefit (Smith and Rao, 1987). Although some samples retain remnant morphological structures of various macerals, the coals are overall petrologically similar and morphologically homogeneous.

Mean-maximum vitrinite reflectance (Ro_{max}, %): 1.63-2.66; locally to 9.46

HERENDEEN BAY COALFIELD

DESCRIPTION

LOCATION

The Herendeen Bay coalfield is located along the shore of the Bering Sea on the northern Alaska Peninsula, between Herendeen Bay and Port Moller, about 350 mi southwest of Kodiak and 100 mi southwest of the Chignik coalfield (fig. 17).

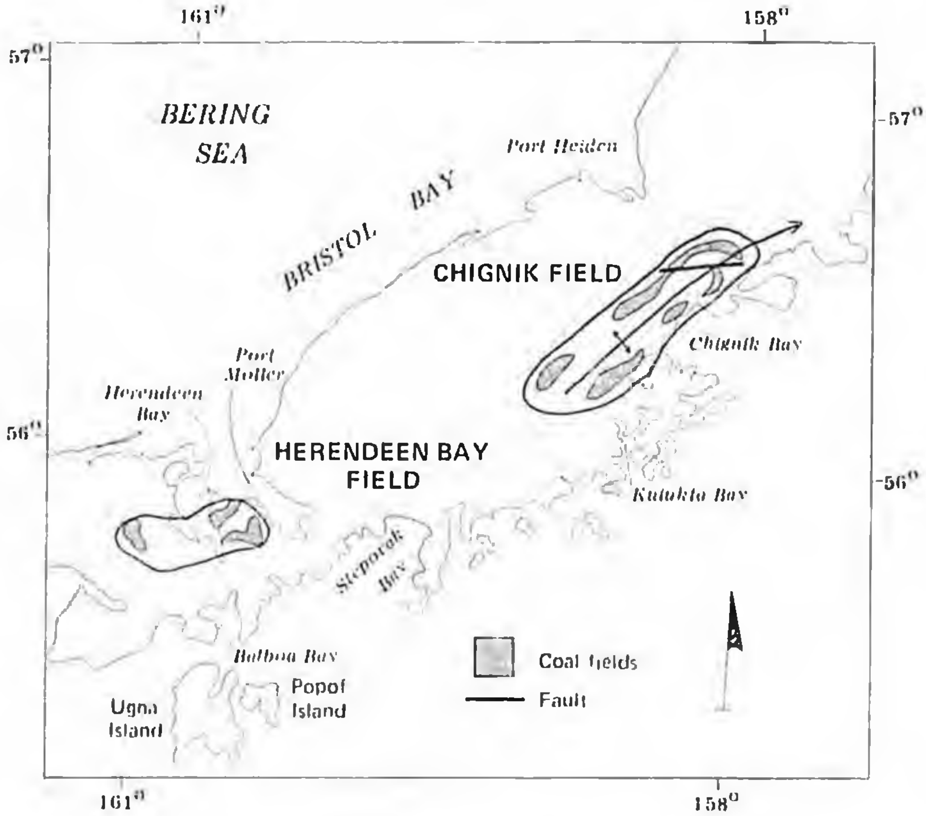

Figure 17. Index map of the southern Alaska Peninsula showing the locations of the Herendeen Bay and Chignik coalfields (modified from Merritt and Hawley, 1986).

AREA

The belt of coal-bearing rocks is about 25 mi long and 5 mi wide. The field covers an area of 100 mi² (fig. 18).

GEOLOGY

The high-rank coal deposits of the Herendeen Bay field occur mainly in the Coal Valley Member of the Upper Cretaceous Chignik Formation (fig. 19), which is over 1,500 ft thick. Typical sections of coal-bearing strata are shown in figure 20, and a seam at Mine Harbor in figure 21. Beds are moderately folded and locally broken by small-scale faults.

MINING HISTORY

Between 1889 and 1904, the Herendeen Bay field was the site of local coal developments, small-scale mining, and underground exploration. Mine Harbor was the main focus of activity. However, very little commercial production occurred.

The mining potential of the coalfield has not been thoroughly investigated, and it may hold considerable potential for development of small mines.

ACCESS

The Herendeen Bay field is accessible to tidewater, but Herendeen Bay is blocked by ice several months each year. The most likely scenario for coal shipment would require the construction of an overland transportation system (road, rail, conveyor, aerial tramway, or slurry pipeline) 15 mi through a low pass to Balboa Bay, on the Pacific side of the Alaska Peninsula (fig. 17).

COAL RESOURCES

Coal resources are concentrated in five main areas: Mine Creek/Mine Harbor, Coal Bluff, Coal Valley, Lawrence Valley, and Coal Point. A large number of closely-spaced coal beds up to 7 ft thick have been found within these areas; however, thickness of beds averages 2 to 4 ft. One 200-ft section contains an aggregate 26 ft of coal.

Resources are summarized as follows (overburden depth to 2,000 ft):

Measured	10 million tons
Identified	130 million tons
Hypothetical	1,500 million tons

LAND STATUS

The Herendeen Bay coalfield occupies land owned by the state of Alaska and the Aleut Native Corporation.

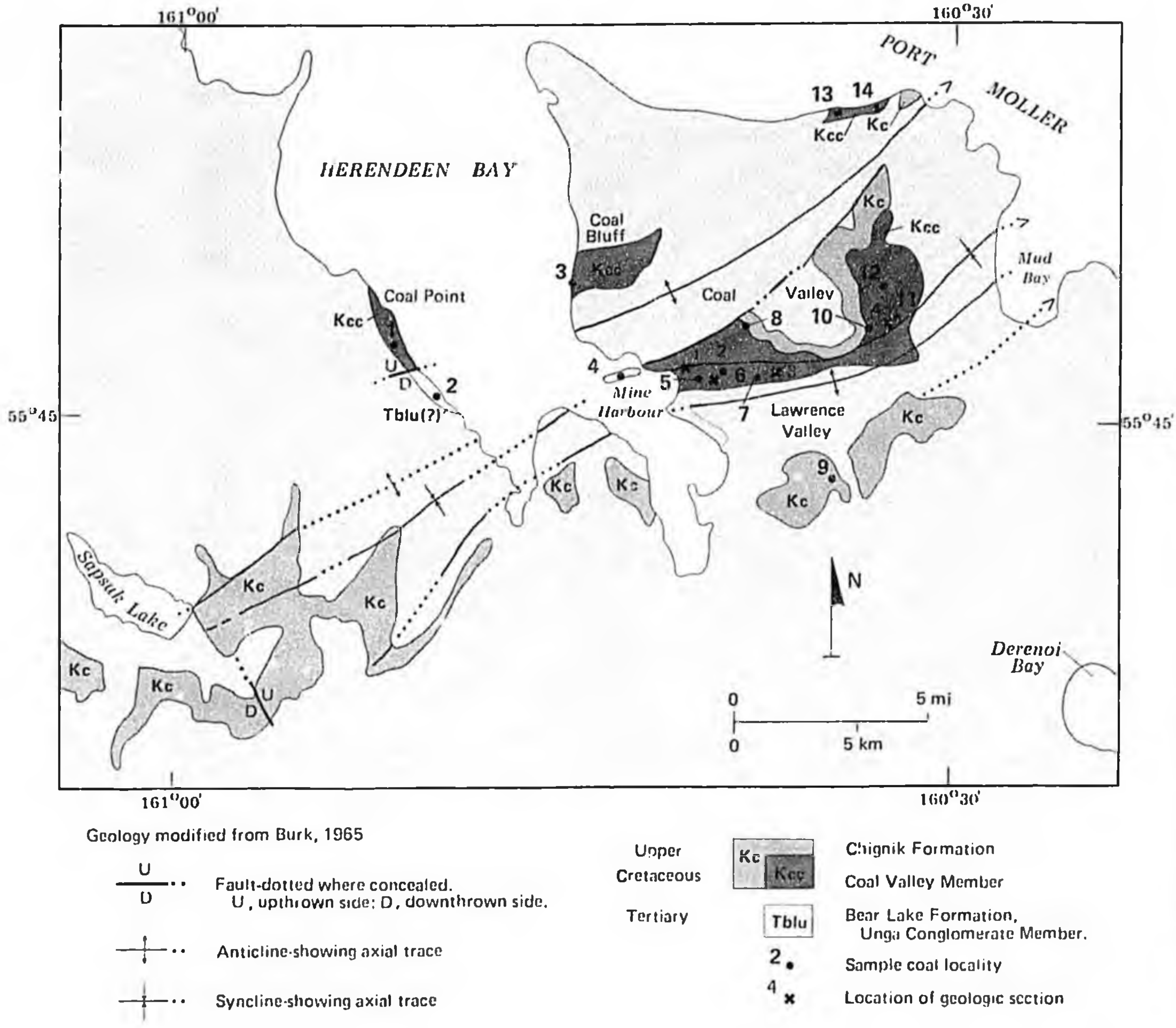

Figure 18. Generalized geologic map of the Herendeen Bay coalfield, Alaska Peninsula (from Merritt and McGee, 1986).

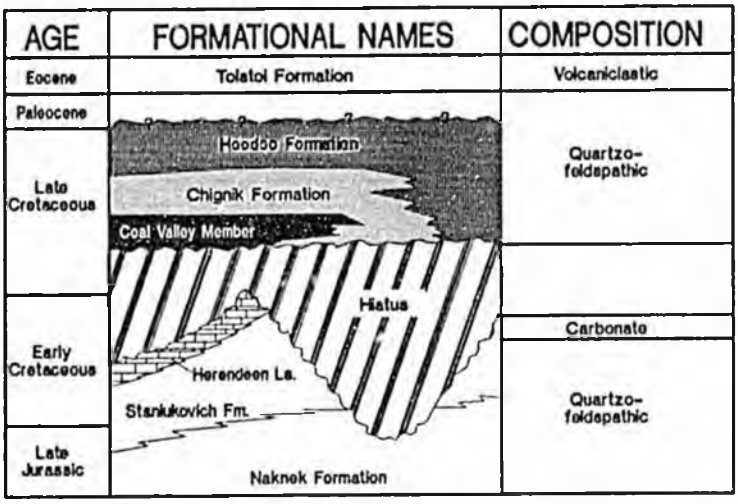

Figure 19. Generalized stratigraphy in the Herendeen Bay coalfield (modified after Burk, 1965; Moore, 1974; and Mancini and others, 1978).

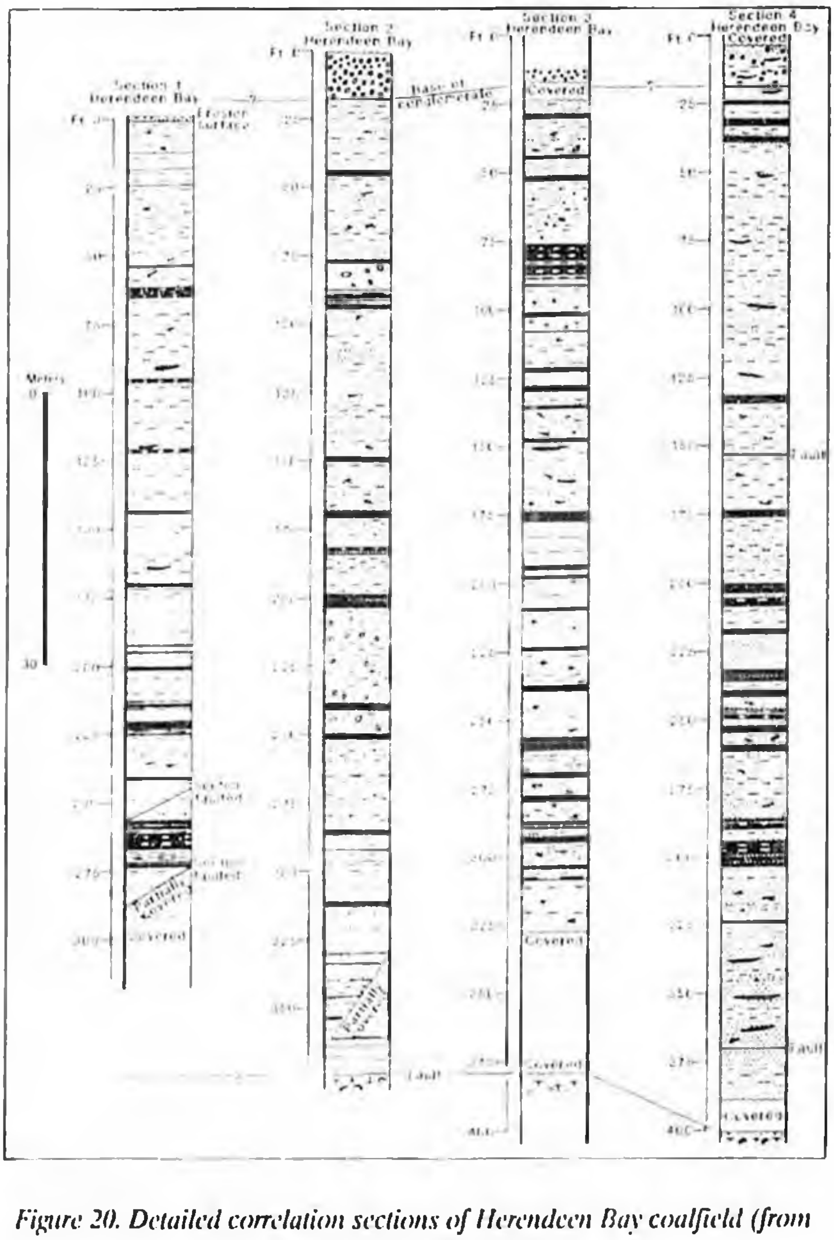

Figure 20. Detailed correlation sections of Herendeen Bay coalfield (from Merritt and McGee, 1986).

Figure 21. One of the thicker coal seams at Mine Harbor, Herendeen Bay field. (Photo by R.D. Merritt, 1984.)

Herendeen Bay Coalfield Data

COAL QUALITY

Rank: High volatile bituminous, typically hvBb.

Heating content: Range 8,400-12,900 Btu/lb; Average 11,060 Btu/lb

Proximate analysis:

	Range (%)	Average (%)
Moisture	1.80-10.09	4.29
Volatile matter	28.41-48.95	34.13
Fixed carbon	29.88-57.89	48.80
Ash	2.52-33.23	12.78

Ultimate analysis:

	Range (%)	Average (%)
Carbon	56.71-64.52	59.08
Hydrogen	4.38-5.09	4.64
Nitrogen	0.35-0.90	0.74
Oxygen	18.47-24.10	22.00
Sulfur	0.29-4.68	0.76
Ash	2.52-33.23	12.78

Major-oxide composition of ash (avg. in %):

SiO_2	45.2	MgO	1.8
Al_2O_3	27.6	P_2O_5	0.6
Fe_2O_3	2.8	Na_2O	0.5
CaO	5.4	MnO	0.1
K_2O	0.7	SO_3	1.7
TiO_2	2.0	Undet.	11.6

Trace elements in coal ash (avg. in ppm):

Barium	860	Molybdenum	63
Boron	168	Nickel	43
Cadmium	1	Scandium	23
Chromium	226	Strontium	600
Cobalt	282	Vanadium	154
Copper	81	Ytterbium	5
Gallium	27	Yttrium	51
Lead	38	Zinc	138
Lithium	88	Zirconium	250
Manganese	269		

Trace elements in coal (avg. in ppm):

Antimony	0.9	Selenium	0.7
Arsenic	4.8	Thorium	3
Fluorine	143	Uranium	1.6
Mercury	0.05		

Fusibility of ash (°F):

Initial deformation	2701
Softening temperature	2800+
Fluid temperature	2800+

Free-swelling index: 0-1.5

Hardgrove grindability index: 52

Coking potential: Poor caking and coking properties.

COAL PETROLOGY

Avg. composition, volume, mineral-matter-free basis, in %:

Vitrinite	78.5
Pseudovitrinite	0.1
Gelinite	2.7
Corpocollinite	0.7
Vitrodetrinite	8.4
Total vitrinite	90.4
Fusinite	2.5
Semifusinite	1.1
Sclerotinite	0.4
Macrinite	0.6
Inertodetrinite	2.2
Total inertinite	6.8
Cutinite	0.4
Sporinite	0.8
Resinite	0.7
Exsudatinite	0.2
Suberinite	0.1
Liptodetrinite	0.6
Total liptinite	2.8

Mean-maximum vitrinite reflectance (Ro_{max}, %):

Range 0.55-0.90
Average 0.65

Locality (See figure 18)	Ro_{max} (%)
1	0.66
2	0.27
3	0.67
4	0.62
5	0.60
6	0.66
7	0.59
8	0.67
9	0.90
10	0.69
11	0.58
12	0.61
13	0.60
14	0.55

CHIGNIK COALFIELD

DESCRIPTION

LOCATION

The Chignik field, about 250 mi southwest of Kodiak and 100 mi northeast of the Herendeen Bay field, lies on the northwest shore of Chignik Bay, which indents the south side of the Alaska Peninsula (fig. 17).

AREA

The belt of coal-bearing rocks is about 30 mi long and 1 to 6 mi wide, an estimated area of 100 mi² (fig. 22).

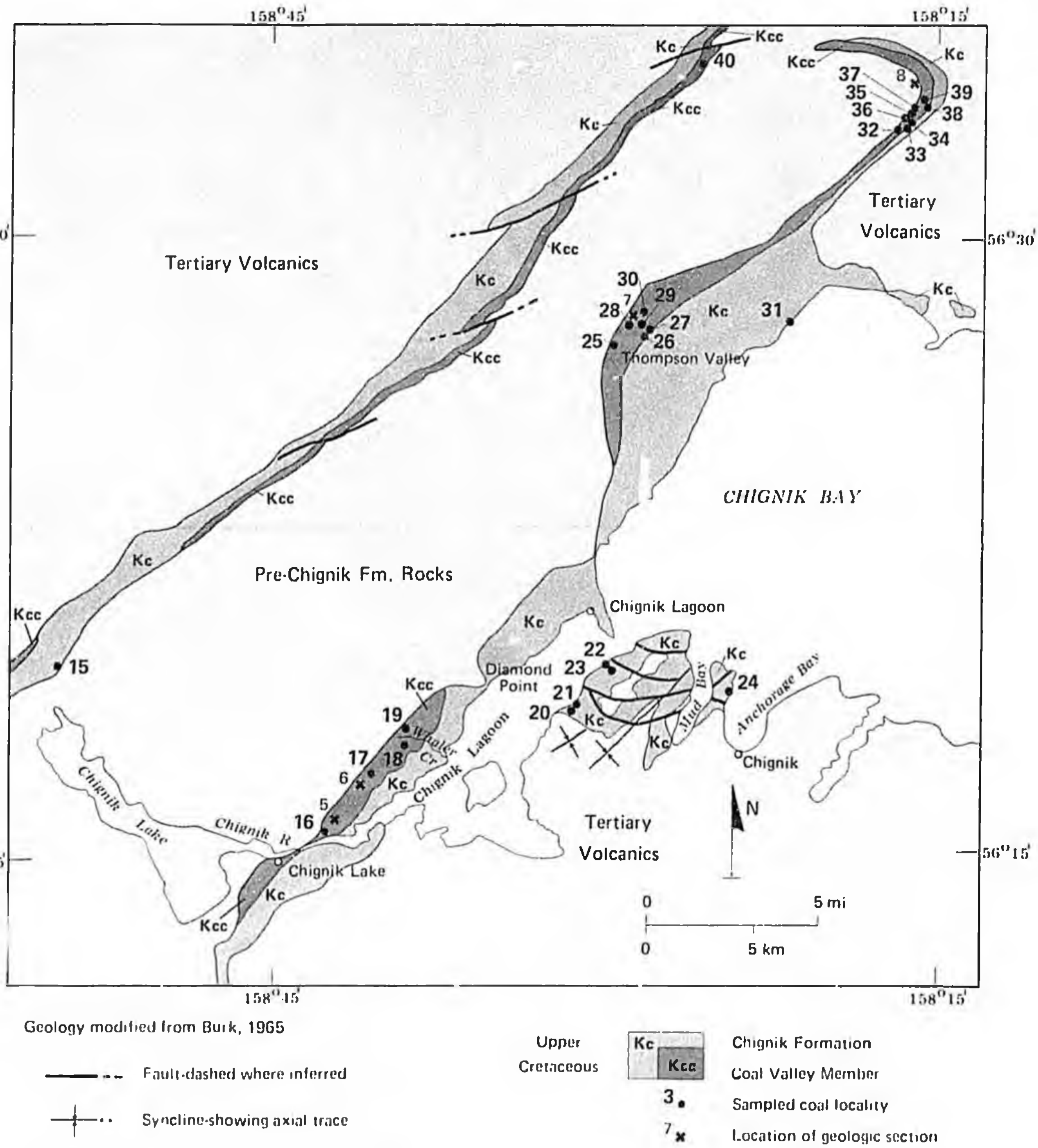

Figure 22. Generalized geologic map of the Chignik coalfield, Alaska Peninsula (from Merritt and McGee, 1986).

GEOLOGY

Coal deposits of the Chignik field lie within the Coal Valley member of the Upper Cretaceous Chignik Formation (fig. 23). This unit of cyclic nearshore marine and nonmarine sedimentation ranges in thickness to 1,500 ft and is composed of sandstone, pebble-cobble conglomerate, siltstone, shale, and numerous coal beds (fig. 24). Strata are moderately folded and locally faulted. Dips vary from 20° to 35°.

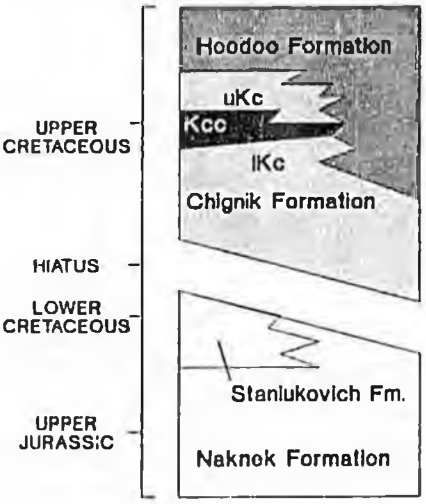

Figure 23. Generalized stratigraphy in the Chignik coalfield. Kcc = Coal Valley Member, Chignik Formation (after Vorobik and others, 1981).

MINING HISTORY

Coal was first discovered on the banks of the Chignik River in 1885. In 1893, the Alaska Mining and Development Company opened a small coal mine on Anchorage Bay near Chignik Lagoon, and the Alaska Packer's Association opened the Chignik River Mine to produce coal for the local fish cannery and for steamers. The Chignik River Mine operated until 1911. Several other small underground mines and prospects were opened in the early 1900s at Thompson Valley (fig. 25), Whaler's Creek, and Hook Bay, but they accounted for very little production. There has been no mining activity since.

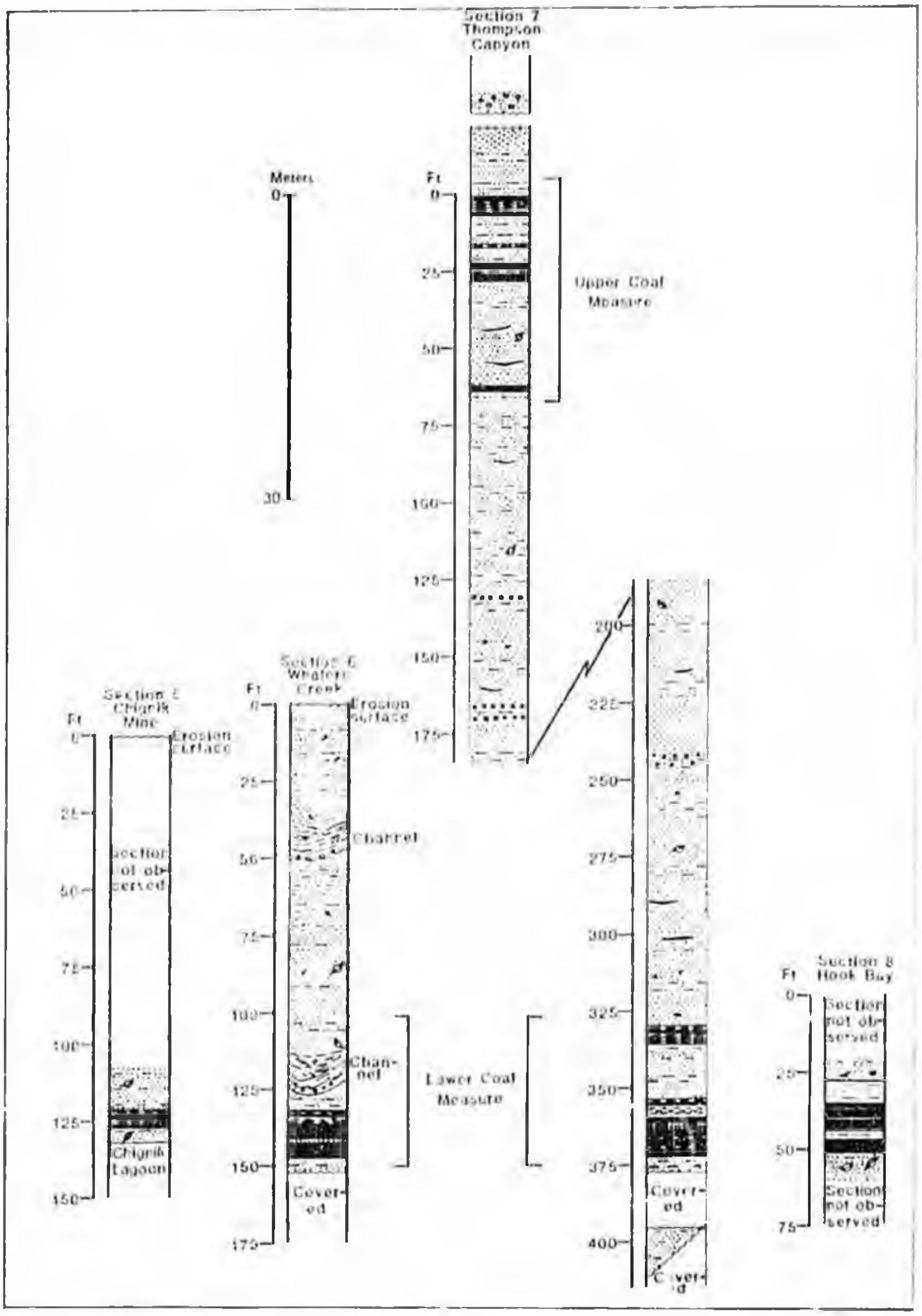

Figure 24. Detailed correlation sections of Chignik coalfield (from Merritt and McGee, 1986).

Although some exploration has been conducted in recent years, the minability of most areas has not been thoroughly investigated. During 1980-81, Resource Associates of Alaska, Inc. (a subsidiary of NERCO Minerals Co.), explored several areas owned by the Bristol Bay Native Corporation in the Chignik field and outlined small potential mining blocks.

ACCESS

Although the Chignik field is accessible to tidewater, Chignik Bay itself has no suitable harbor facilities for large vessels. It would be necessary to construct coal shipment facilities, including overland transportation system (access road and conveyor or aerial tramway) through a low pass to the head of Kuiukta Bay, about 5 mi south of the coal belt.

COAL RESOURCES

Coal resources are concentrated in four main areas: Chignik River, Whaler's Creek, Thompson Valley, and Hook Bay. Coal beds range in thickness to 7 ft, but are typically about 3 ft thick.

Resources are summarized as follows (depths of 0 to 2,000 ft):

Measured	10 million tons
Identified	230 million tons
Hypothetical	1,500 million tons

LAND STATUS

The Chignik coalfield lies within lands owned by the Bristol Bay Native Corporation.

Figure 25. Lower coal horizon at Thompson Valley, Chignik field, Alaska Peninsula. This seam previously supported a small mine. (Photo by R.D. Merritt, 1984.)

Chignik Coalfield Data

COAL QUALITY

Rank: High volatile bituminous, typically hvBb.

Heating content: Range 8,800-13,750 Btu/lb; Average 11,800 Btu/lb

Proximate analysis:

	Range (%)	Average (%)
Moisture	1.09-6.97	4.40
Volatile matter	25.54-40.61	36.33
Fixed carbon	37.86-57.08	47.66
Ash	4.15-30.56	11.61

Ultimate analysis:

	Range (%)	Average (%)
Carbon	56.59-68.45	64.15
Hydrogen	4.12-5.10	4.71
Nitrogen	0.68-0.78	0.71
Oxygen	14.14-24.65	17.46
Sulfur	0.28-4.79	1.36
Ash	4.15-30.56	11.61

Major-oxide composition of ash (avg. in %):

SiO_2	42.0	MgO	2.2
Al_2O_3	29.3	P_2O_5	0.5
Fe_2O_3	5.6	Na_2O	0.2
CaO	4.0	MnO	0.1
K_2O	0.5	SO_3	5.9
TiO_2	1.7	Undet.	8.0

Trace elements in coal ash (avg. in ppm):

Barium	367	Molybdenum	7
Boron	400	Nickel	27
Cadmium	1	Scandium	30
Chromium	55	Strontium	150
Cobalt	13	Vanadium	173
Copper	78	Ytterbium	6
Gallium	30	Yttrium	57
Lead	32	Zinc	83
Lithium	192	Zirconium	217
Manganese	455		

Trace elements in coal (avg. in ppm):

Antimony	0.3	Selenium	0.4
Arsenic	3.7	Thorium	4.0
Fluorine	65	Uranium	1.1
Mercury	0.09		

Fusibility of ash (°F):

Initial deformation	2794
Softening temperature	2800+
Fluid temperature	2800+

Free-swelling index: 0-1.5

Hardgrove grindability index: 46

Coking potential: Poor caking and coking properties.

COAL PETROLOGY

Avg. composition, volume, mineral-matter-free basis, in %:

Vitrinite	78.3
Gelinite	2.0
Corpocollinite	0.4
Vitrodetrinite	10.9
Total vitrinite	91.6
Fusinite	2.0
Semifusinite	1.0
Sclerotinite	0.4
Macrinite	0.5
Inertodetrinite	1.8
Total inertinite	5.7
Cutinite	0.3
Sporinite	0.8
Resinite	0.6
Exsudatinite	0.1
Suberinite	0.1
Alginite	0.1
Liptodetrinite	0.7
Total liptinite	2.7

Mean-maximum vitrinite reflectance (Ro_{max}, %):

Range 0.57-1.76
Average 0.73

Locality (See figure 22)	Ro_{max} (%)
15	0.57
16	0.62
17	0.62
18	0.67
19	0.64
20	0.82
21	1.01
22	0.95
23	0.79
24	1.76
25	0.58
26	0.62
27	0.60
28	0.60
29	0.66
30	0.58
31	0.68
32	0.69
33	0.70
34	0.71
35	0.78
36	0.60
37	0.66
38	0.65
39	0.65
40	0.70

WESTERN ARCTIC COALFIELDS

DESCRIPTION

LOCATION

The Western Arctic region forms a part of the Foothills subprovince in northern Alaska (fig 26). Three specific areas that show the highest potential for near-term development of bituminous coal deposits are Cape Beaufort (or Liz-A syncline), Deadfa, syncline, and Kukpowruk River, west of Howard syncline (fig. 27). The Liz-A syncline is just inland from Cape Beaufort on the Chukchi Sea coast. The Deadfall syncline is 6 mi east of the Chukchi Sea, and the Kukpowruk River area is about 14 mi east of the Chukchi Sea and 25 mi upstream from the mouth of the Kukpowruk River.

AREA

The Cape Beaufort area covers about 30 mi^2. The Deadfall syncline encompasses less than 100 mi^2, and that portion of the Kukpowruk River area under consideration here--the western end of the Howard syncline--has an area of 20 to 30 mi^2. Within these broad areas, several specific mining blocks or units can be defined.

GEOLOGY

The geology of the Western Arctic region is dominated by a series of east-west-trending synclines and anticlines. The synclines contain bituminous coal beds in the Corwin Formation of the Cretaceous-age Nanushuk Group (figs. 28 and 29). In the Western Arctic region, the Corwin Formation varies in thickness from 7,000 to 10,000 ft. The type locality of the Corwin Formation is at Corwin Bluffs (fig. 26), 35 mi west of Cape Beaufort, where 80 or more coal beds over 1 ft thick are exposed. Interbedded with coal seams are sandstones, claystones, siltstones, and carbonaceous shales that formed in a prograding deltaic

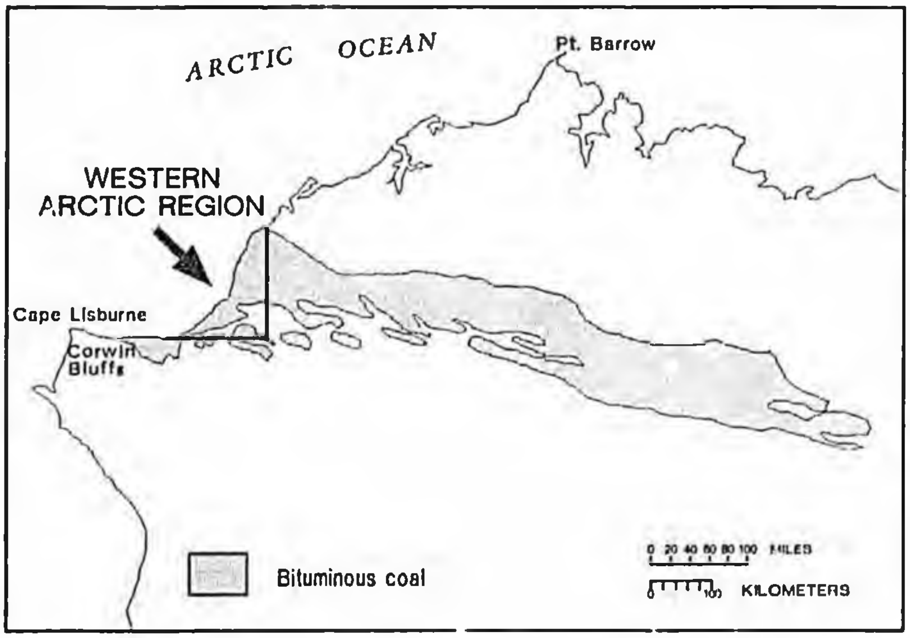

Figure 26. Distribution of bituminous coal deposits in northern Alaska (modified from Knutson, 1981).

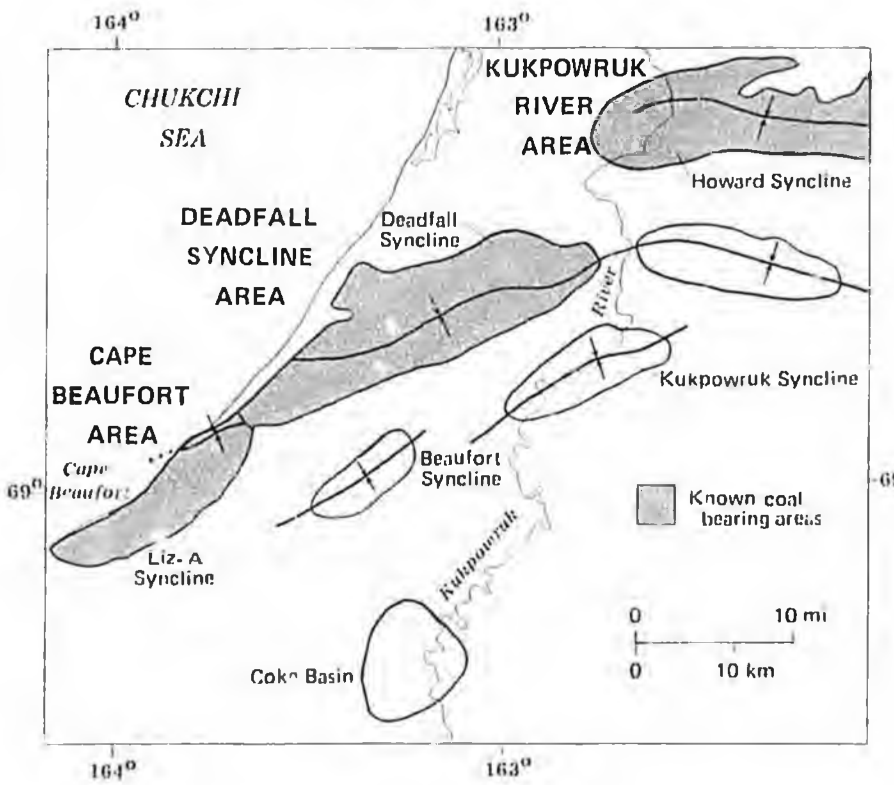

Figure 27. Important bituminous coal-bearing areas and structural features of the Western Arctic region (modified from Chapman and Sable, 1960).

system in swampy coastal lowlands. The strata are flat-lying to gently dipping (10° to 20°) and their structure is relatively simple (figs. 29 and 30). Rank of the coals increases with the complexity in structure from north to south in the foothills of the Brooks Range.

MINING HISTORY

The coals of the Western Arctic region were first reported by the Beechey expedition of 1826-27. In the late 1800s and early 1900s, coal from the Corwin Bluffs and Cape Beaufort areas was used to fuel whaling ships. A.J. Collier conducted the first geologic reconnaissance of coastal deposits south of Cape Beaufort in 1904.

Morgan Coal Company first explored the coking coal deposit on the Kukpowruk River in 1954, by driving a 70-ft tunnel in the 20-ft-thick bed. The company still holds a U.S. Bureau of Mines preference-right coal lease on 5,000 acres in that area. Union Carbide investigated the Kukpowruk River coking coal deposit from 1961 to 1963,

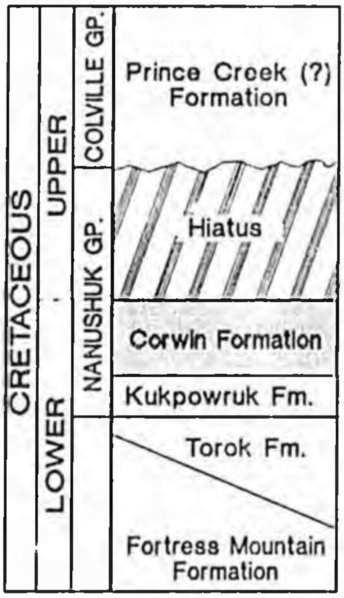

Figure 28. Generalized stratigraphy of the Western Arctic region (modified from Ahlbrandt and others, 1979).

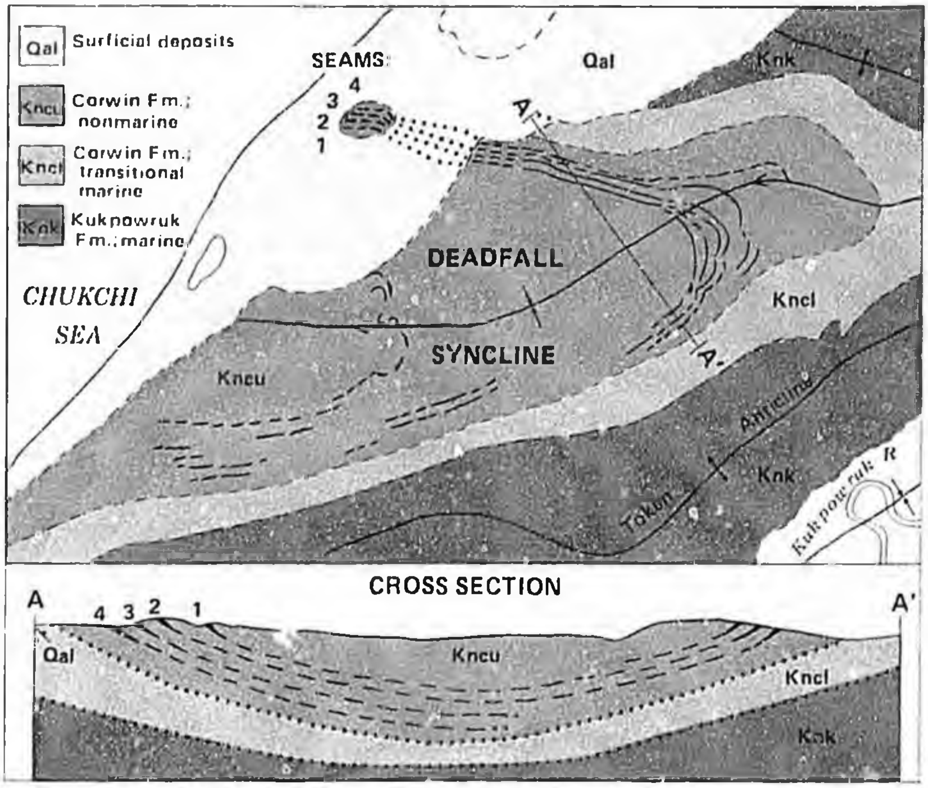

Figure 29. Geologic map and cross section of the Deadfall syncline, Western Arctic region (modified from Callahan and Eakins, 1987).

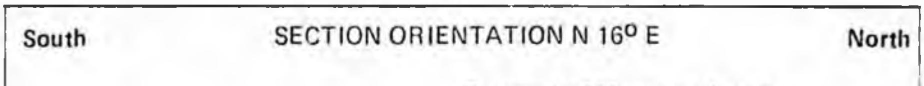

Figure 30. Typical cross sections in the Kukpowruk River area of the Western Arctic (from Knutson, 1981).

and Kaiser Engineers performed detailed mining and economic evaluations from 1970 to 1977. From 1981 to 1986, the State of Alaska and the North Slope Borough conducted extensive exploration and predevelopment site investigations of coal deposits at Cape Beaufort and in the Deadfall syncline area.

ACCESS

Access to the Deadfall syncline deposits was thoroughly studied by the Western Arctic Coal Development Project (Arctic Slope Consulting Engineers, 1986). A 5.4-mi haul road would connect the mine site with a port facility and berthing area for barge traffic. A 2,800-ft lead-in channel would be dredged to an operating depth of 13 ft. Coal would be stored at the barge loading facility for domestic shipment during the ice-free season. Coal for foreign export would be transported to a separate ice-free port facility with a large storage capacity and a harbor for berthing and loading of seagoing carriers. Large-volume shipments from either the Cape Beaufort or Kukpowruk River areas would probably follow a similar plan, unless a long-distance rail line were completed to the Western Arctic region.

Figure 31. Twenty-foot thick coal seam at Kukpowruk River, Western Arctic region. (Photo by G.R. Eakins, 1982.)

COAL RESOURCES

The North Slope, including the National Petroleum Reserve of Alaska (NPRA) and bordering areas to the east and west of it, holds as much as 4 trillion tons of coal. The Western Arctic region west of NPRA may contain up to 1 trillion tons of coal. Approximately 60 percent of North Slope coal is estimated to be of bituminous rank. Ten percent or more of the stratigraphic section from some wells consists of coal. Between 150 and 200 coal beds, 60 percent of which are over 3.5 ft thick, have been correlated in the Corwin Formation of the Western Arctic. The thickest identified outcropping seam in the region is at Kukpowruk River (fig. 31). At Cape Beaufort, coal beds range in thickness to 9 ft in outcrops (fig. 32) and to 17 ft in drill holes; at Deadfall syncline, coal beds range in thickness from 4.5 to 13 ft.

At a minimum, the Western Arctic region contains 125 million tons of strippable coal resources amenable to modern mechanized mining; further exploration will delineate other strippable resources. Plentiful additional resources can be developed by underground mining methods. Domestic uses of Western Arctic coal are heat and power generation for villages in northwest Alaska and power production for other large-scale mining such as the Red Dog zinc mine north of Kotzebue.

Coal resources at Cape Beaufort, Deadfall syncline, and Kukpowruk River are listed below in millions of tons (overburden depths from 0 to 3,000 ft):

	Cape Beaufort	Deadfall syncline	Kukpowruk River
Measured	45	60	20
Identified	390	500	275
Hypothetical	1,700	5,000	1,200

LAND STATUS

Lands in the Western Arctic coalfields region are owned by Arctic Slope Regional Corporation, and leased by the Morgan Coal Company (U.S. Bureau of Mines preference-right lease to 5,000 acres in the Kukpowruk River area).

Figure 32. Sampling a thick coal bed north of Cape Beaufort, Western Arctic region, 1981. (Photo courtesy of P.D. Rao, University of Alaska MIRL.)

Western Arctic Coalfields Data
CAPE BEAUFORT

COAL QUALITY

Rank: hvAb-hvCb

Heating content:	Range	9,100-12,700 Btu/lb
	Average	12,300 Btu/lb

Proximate analysis (range in %, mean in parentheses):

Moisture	2.5-7 (4.5)	Fixed carbon	37-55 (46.8)
Volatile matter	22-33 (29.7)	Ash	8-27 (16.0)

Ultimate analysis (range in %, mean in parentheses):

Carbon	46-71 (58.3)	Oxygen	13-25 (19.1)
Hydrogen	3.5-5 (4.5)	Sulfur	0.2-0.4 (0.3)
Nitrogen	0.7-1.5 (1.1)	Ash	8-27 (16.7)

Major-oxide composition of ash (avg. in %):

SiO_2	49.7	MgO	2.7
Al_2O_3	25.1	SO_3	0.6
Fe_2O_3	3.2	P_2O_5	0.3
CaO	6.2	MnO	0.1
TiO_2	1.1	Undet.	7.5

Trace elements in coal ash (avg. in ppm):

Boron	440	Nickel	40
Chromium	55	Silver	3.5
Cobalt	40	Tin	295
Copper	40	Vanadium	130
Gallium	30	Zinc	110
Lead	55	Zirconium	500
Molybdenum	5		

Trace elements in raw coals (avg. in ppm):

Boron	75	Nickel	8
Chromium	15	Silver	1
Cobalt	8	Tin	35
Copper	9	Vanadium	30
Gallium	6	Zinc	25
Lead	10	Zirconium	100
Molybdenum	1		

Fusibility of ash (reducing temperature, °F):

Initial deformation	2320
Softening temperature	2410
Fluid temperature	2520

Free-swelling index: 0-6

Hardgrove grindability index: 58

Coking potential: Increased with depth; coal from 200-ft shows pronounced coking characteristics.

COAL PETROLOGY

Avg. composition, volume, mineral-matter-free basis, in %:

Vitrinite	62.2
Pseudovitrinite	10.0
Gelinite	0.7
Phlobaphinite	0.4
Pseudophlobaphinite	1.0
Sporinite	1.2
Resinite	0.8
Cutinite	0.1
Alginite	0.0
Exsudatinite	0.1
Thick cutinite	0.1
Suberinite	0.0
Other liptinite	0.0
Fusinite	0.8
Semifusinite	14.3
Macrinite	1.7
Globular macrinite	1.3
Inertodetrinite	5.3
Sclerotinite	0.0

Mean-maximum vitrinite reflectance (Ro_{max}, %): 0.70

DEADFALL SYNCLINE

COAL QUALITY

Rank: hvAb-hvCb

Heating content:	Range	10,900-13,200 Btu/lb
	Average	12,900 Btu/lb

Proximate analysis (range in %, mean in parentheses):

Moisture	2.5-8 (4.6)	Fixed carbon	35-56 (53.9)
Volatile matter	22-36 (33.9)	Ash	5.5-22 (7.6)

Ultimate analysis (range in %, mean in parentheses):

Carbon	451-65 (59.4)	Oxygen	17-27 (23.3)
Hydrogen	3.7-5.1 (4.6)	Sulfur	0.2-0.3 (0.2)
Nitrogen	0.8-1.4 (1.1)	Ash	5.5-22 (11.4)

Major-oxide composition of ash (avg. in %):

SiO_2	30.9	MgO	6.7
Al_2O_3	29.2	SO_3	1.5
Fe_2O_3	4.8	P_2O_5	0.8
CaO	17.5	MnO	0.0
TiO_2	0.7	Undet.	0.5

Trace elements in coal ash (avg. in ppm):

Boron	300	Nickel	25
Chromium	50	Silver	2
Cobalt	30	Tin	180
Copper	35	Vanadium	95
Gallium	30	Zinc	100
Lead	50	Zirconium	220
Molybdenum	5		

Trace elements in raw coals (avg. in ppm):

Boron	55	Nickel	7
Chromium	12	Silver	1
Cobalt	8	Tin	25
Copper	10	Vanadium	20
Gallium	5	Zinc	18
Lead	10	Zirconium	80
Molybdenum	1		

Fusibility of ash (reducing temperature, °F):

Initial deformation	2093
Softening temperature	2143
Fluid temperature	2189

Free-swelling index: 0-6

Hardgrove grindability index: 56

Coking potential: Similar to Cape Beaufort coals.

COAL PETROLOGY

Avg. composition, volume, mineral-matter-free basis, in %:

Vitrinite	58.1
Pseudovitrinite	10.7
Gelinite	0.9
Phlobaphinite	0.1
Pseudophlobaphinite	1.1
Sporinite	1.7
Resinite	1.0
Cutinite	0.2
Alginite	0.0
Exsudatinite	0.0
Thick cutinite	0.3
Suberinite	0.0
Other liptinite	0.0
Fusinite	2.0
Semifusinite	16.4
Macrinite	2.4
Globular macrinite	0.3
Inertodetrinite	4.8
Sclerotinite	0.0

Mean-maximum vitrinite reflectance (Ro_{max}, %): 0.70

KUKPOWRUK RIVER

COAL QUALITY

Rank: hvAb-hvCb

Heating content:

Range	11,900-14,100 Btu/lb
Average	13,800 Btu/lb

Proximate analysis (range in %, mean in parentheses):

Moisture	0.8-10 (2.8)	Fixed carbon	52-60 (58.5)
Volatile matter	31-40 (35.2)	Ash	2.5-15 (3.5)

Ultimate analysis (range in %, mean in parentheses):

Carbon	57-77 (70.0)	Oxygen	12-18 (14.5)
Hydrogen	4.5-5.6 (5.1)	Sulfur	0.2-0.5 (0.3)
Nitrogen	1.0-1.6 (1.3)	Ash	2.5-15 (8.8)

Major-oxide composition of ash (avg. in %):

SiO_2	51.5	MgO	3.0
Al_2O_3	25.5	SO_3	0.5
Fe_2O_3	4.8	P_2O_5	0.6
CaO	3.5	MnO	0.1
TiO_2	1.0	Undet.	6.5

Trace elements in coal ash (avg. in ppm):

Boron	--	Nickel	80
Chromium	40	Silver	--
Cobalt	35	Tin	--
Copper	150	Vanadium	65
Gallium	50	Zinc	--
Lead	150	Zirconium	190
Molybdenum	--		

Trace elements in raw coals (avg. in ppm):

Boron	--	Nickel	7
Chromium	4	Silver	--
Cobalt	4	Tin	--
Copper	12	Vanadium	9
Gallium	4	Zinc	--
Lead	14	Zirconium	19
Molybdenum	--		

Fusibility of ash (reducing temperature, °F):

Initial deformation	2040
Softening temperature	2110
Fluid temperature	2390

Free-swelling index: 0-6

Hardgrove grindability index: --

Coking potential: Significant coking, properties; generally soft-coking.

COAL PETROLOGY

Avg. composition, volume, mineral-matter-free basis, in %:

Vitrinite	60.9
Pseudovitrinite	16.3
Gelinite	1.7
Phlobaphinite	0.3
Pseudophlobaphinite	1.0
Sporinite	1.9
Resinite	0.7
Cutinite	0.4
Alginite	0.1
Exsudatinite	0.0
Thick cutinite	0.3
Suberinite	0.1
Other liptinite	0.0
Fusinite	0.6
Semifusinite	11.4
Macrinite	1.1
Globular macrinite	0.3
Inertodetrinite	2.9
Sclerotinite	0.0

Mean-maximum vitrinite reflectance (Ro_{max}, %): 0.73

OUTLOOK FOR COAL DEVELOPMENT IN ALASKA

As the chief energy resource of the world today, where escalating energy needs sap rapidly declining petroleum resources, coal will play an increasing part in the world energy supply. Coal is the primary source of fuel for electrical-power generation in the United States.

Alaska's total coal resources are estimated at between 5.5 and 6.0 trillion tons, over half of which are of bituminous rank. The total energy equivalent (in Btu) of all the coal in Alaska exceeds by several orders of magnitude that of all known oil reserves in the State. The energy equivalent of Alaska's bituminous coal resources alone is estimated to be more than 1,000 Prudhoe Bays (original recoverable reserves of about 10 billion barrels).

Because of its vast coal resources, Alaska promises to become an important coal-mining and export center for the next decade and well into the next century. The potential for coal development in Alaska is unlimited, and Alaska's strategic position on the northern Pacific Rim places it in the center of expanding trade routes. Alaska is, in fact, closer to Far East markets than Australia, Canada, or South Africa.

The low sulfur content of Alaska's coal (less than 0.5 percent) is a chief attraction for Pacific Rim industrial buyers. The environmental significance of low-sulfur coal will increase dramatically in the future; environmental problems encountered in mining, preparation, and use of high-sulfur coal can be avoided with low-sulfur Alaska coal.

The sulfur content of Alaska coals, on average, is about half that of the lowest-sulfur coals of the contiguous U.S. Alaska's coals are uniquely low in the acid-producing, pyritic form of sulfur that causes acid-mine drainage in other U.S. coal-producing regions, and lower mean annual temperatures and local relative aridity act to reduce oxidation effects on Alaska's coals when exposed to the environment.

Alaska coals produce low sulfur-oxide (SO_x) emissions. Most Alaska coals meet the USEPA emission standards (1.2 lb SO_2/MM Btu) for direct combustion. Because nitrogen content is also low, the low combined emission of SO_x and NO_x gases during combustion make Alaska's coals among the most environmentally safe in the world. Alaska's high-rank coals also possess good ash-fusion characteristics and low moisture and metallic trace-element content.

Coal mining has taken place in Alaska for 130 yr. If this long history of coal development proves one thing, it is that coal mining can exist in harmony with the unique Alaska environment. The Usibelli Coal Mine near Healy (in interior Alaska) provides an example--from its longstanding commitment to land-restoration programs--that coal mining can be conducted in Alaska with both economic success and environmental restraint. As coal mining activities increase in the state, Alaska has the opportunity to serve as a model for mining efficiency and prudent land-restoration practices in Arctic and Subarctic regions.

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GLOSSARY OF TERMS

Ash Ash is determined during the proximate analysis, but also forms an integral part of the ultimate analysis. (See Ultimate analysis.)

Ash content The ash content of a coal is the percentage of incombustible material in coal determined under standardized conditions by burning a sample and measuring the ash. (See Proximate analysis.)

Carbon Carbon is determined by catalytic burning in oxygen and the subsequent measurement of the amount of carbon dioxide formed. Total organic carbon is equal to the total carbon content less the carbonate carbon. Total carbon in a sample is greater than the fixed carbon content. (See Ultimate analysis.)

Coking and metallurgical potential Coking and metallurgical potentials refer to the degree to which coals swell, fuse, and run together to produce a strong coke substance under certain specified conditions. Coking or caking coals are the most important of the bituminous coals because of their suitability for the production of coke for metallurgical uses. Coking coals are typically low-ash, low-sulfur, and low- to medium-volatile bituminous rank.

Fixed carbon content Fixed carbon is the solid combustible matter of coal remaining after the removal of moisture, volatile matter, and ash. It is determined by difference and is expressed as a percentage. (See Proximate analysis.)

Fluid temperature The point indicated by the spreading out of the completely melted ash cone into a flat layer. (See Fusibility of ash.)

Free-swelling index (FSI) FSI is a measurement obtained by the rapid heating of a coal sample in a non-restraining crucible. It ranges on a scale of 0 to 9, where noncaking and nonswelling coals are 0 on the scale. FSI gives an indication of the caking characteristics of a given coal.

Fusibility of ash (F°) Ash-fusibility temperatures vary with the character of coals, particularly the ash content, and is less for low-rank coals. Among the types performed are either a 3-point or 4-point (reducing atmosphere only) ash fusibility or an 8-point (reducing and oxidizing atmospheres) ash fusibility. The melting temperature and deformational changes of an ash cone are measured at various stages. In the 3-point test, temperatures are measured at the point of initial deformation, softening point, and fluid stage. In the 4-point test, an additional measurement is taken at the hemispherical stage, as follows:

Point of initial deformation The tip of the ash cone begins to deform.

Softening point The point where the ash cone height is equal to one-half its width.

Hemispherical stage The point where the ash cone height is equal to its width.

Fluid temperature The point indicated by the spreading out of the completely melted ash cone into a flat layer.

Hardgrove grindability index (HGI) HGI is a measurement that peaks in the bituminous ranks and is less for lignites and anthracites. Intermediate-rank coals are softer and easier to grind, whereas lower and higher rank coals are more difficult to grind and hence have lower grindability indices. The grindability index is calculated by measuring the quantity of -200 mesh fine coal produced at different moisture levels; that is, at two or three temperatures. The relative ease of pulverization is compared to a standard coal having an HGI of 100.

Heating content or heating value Heating content refers to the amount of heat obtainable from coal expressed in British thermal units (Btu) per pound. It is determined by the use of an adiabatic bomb calorimeter, which measures the temperature rise after combustion of a coal sample in an oxygen bomb.

Hemispherical stage The point where the ash cone height is equal to its width. (See Fusibility of ash.)

Hydrogen Hydrogen is determined by catalytic burning in oxygen and the subsequent measurement of the water formed and absorbed by a desiccant. (See Ultimate analysis.)

Major-oxide composition of ash Major oxides include SiO_2, Al_2O_3, Fe_2O_3, TiO_2, CaO, MgO, Na_2O, K_2O, P_2O_5, and SO_3. These compounds typically compose over 99 percent of coal ash.

Moisture content Moisture content includes surface moisture that can be removed by natural drying, and inherent moisture that is contained structurally in the coal substance. Surficial water on coal is free or adherent. Inherent moisture is held physically by vapor pressure or other phenomena. The total moisture content also includes chemically bound water. The equilibrium or bed moisture (for classification by rank) is the inherent moisture-holding capacity of a given coal (in situ) measured at 30°C with a 97 percent relative humidity atmosphere. (See Proximate analysis.)

Nitrogen Nitrogen is determined typically by a chemical digestion with the contained nitrogen converted to ammonia by the Kjeldahl-Gunning method. (See Ultimate analysis.)

Oxygen Oxygen is estimated by difference; total carbon, hydrogen, sulfur, nitrogen, and ash are subtracted from 100 percent. (See Ultimate analysis.)

Point of initial deformation The tip of the ash cone begins to deform. (See Fusibility of ash.)

Proximate analysis A proximate analysis of coal includes determinations of the moisture, volatile matter, ash, and fixed carbon (by difference) content by prescribed methods. A complete proximate analysis is reported on as-received, moisture-free, and moisture- and ash-free bases and totals 100 percent. Sometimes, analyses are reported on an equilibrium-bed-moisture basis as well. Unless otherwise stated, analyses are assumed to be on an as-received basis.

Rank Rank is the basis of coal classification in the natural series from lignite to anthracite and refers to the degree of metamorphism of coal. Higher rank indicates greater metamorphism. Bituminous coals and anthracites are considered to be high-rank; subbituminous coals and lignites, low-rank. Classes of high-rank coals are:

ASTM* abbreviation	Rank (in decreasing order)
ma	meta-anthracite
an	anthracite
sa	semianthracite
lvb	low volatile bituminous
mvb	medium volatile bituminous
hvAb	high volatile A bituminous
hvBb	high volatile B bituminous
hvCb	high volatile C bituminous

*American Society for Testing and Materials.

Softening point The point where the ash cone height is equal to one-half its width. (See Fusibility of ash.)

Sulfur Total sulfur is composed of pyritic (or sulfide), organic, and sulfate forms. Pyritic sulfur is combined with iron in the minerals pyrite and marcasite. Pyritic sulfur is usually the most abundant form in coals and is chiefly responsible for acid mine drainage. Organic sulfur, typically the most abundant form in Alaskan coals, is bonded to the carbon structure. Sulfates form mainly by weathering, into calcium and iron varieties. Three methods used for sulfur determinations are Eschka, high-temperature combustion, and bomb-washing. (See Ultimate analysis.)

Trace elements in coal and coal ash Trace element analysis is important for environmental concerns attendant to coal mining and use. The most important trace elements are arsenic, beryllium, boron, cadmium, chromium, cobalt, copper, fluorine, gallium, germanium, indium, lanthanum, lead, mercury, molybdenum, nickel, selenium, thallium, titanium, uranium, vanadium, yttrium, and zinc. Trace-element analysis is performed by atomic absorption, spark-source mass spectrophotometry, X-ray fluorescence, and neutron activation.

Ultimate analysis An ultimate analysis of coal determines the contents of the elements carbon, hydrogen, sulfur, nitrogen, oxygen (by difference), and ash. These quantities always total 100 percent.

Vitrinite reflectance Vitrinite reflectance is a measurement of the extent to which light is reflected from the surface of a polished coal sample. The measurements are made on the vitrinitic maceral components of the coal substance and are used in the determination of rank and coking characteristics of coal. Maximum reflectances are measured in oil for at least 100 vitrinite particles.

Volatile matter content Volatile matter includes substances in coal other than moisture that are given off as gas and vapor during combustion. (See Proximate analysis.)

ALASKA'S HIGH-RANK COALS

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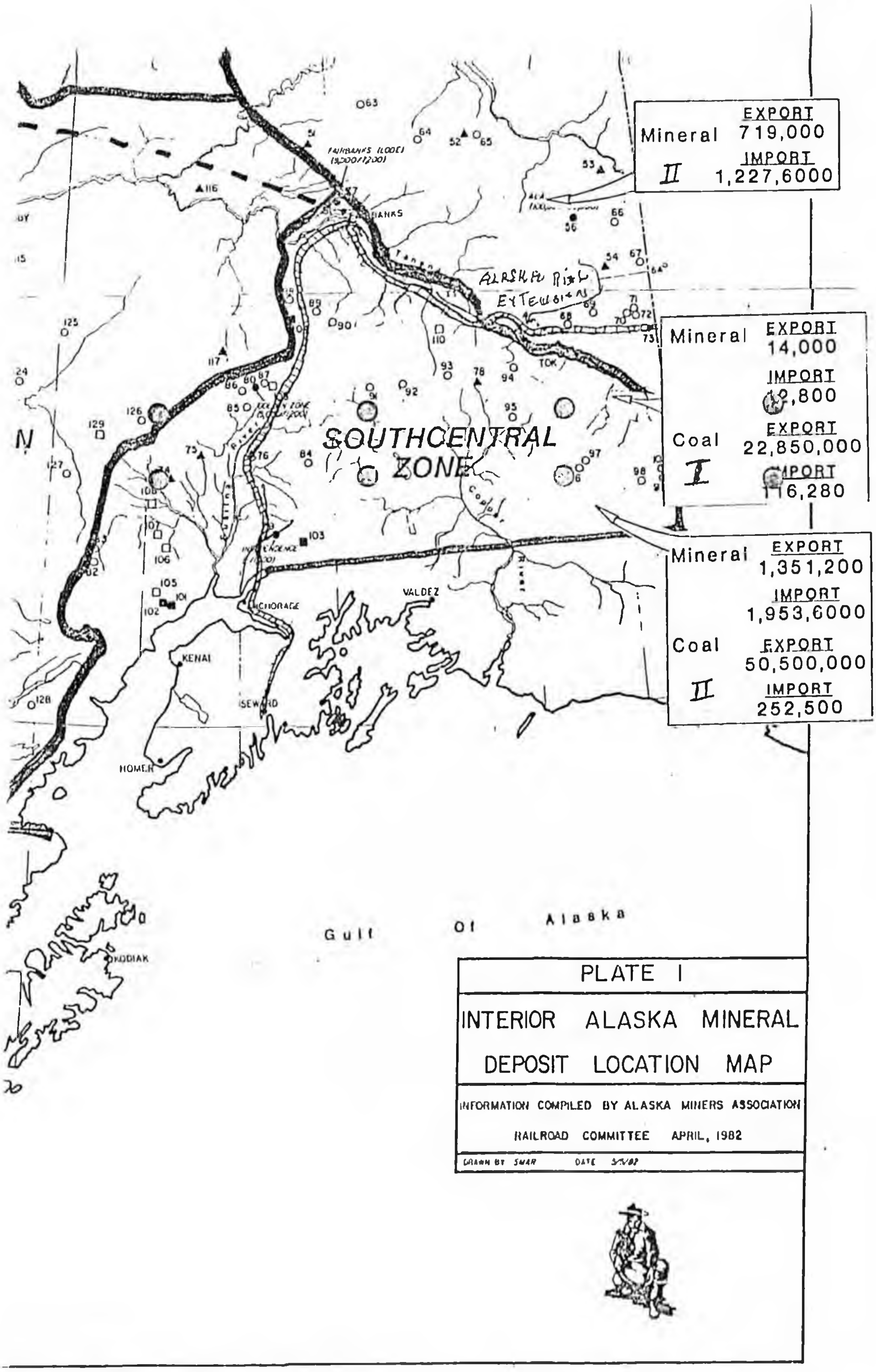

PLATE I

INTERIOR ALASKA MINERAL DEPOSIT LOCATION MAP

INFORMATION COMPILED BY ALASKA MINERS ASSOCIATION RAILROAD COMMITTEE APRIL, 1982

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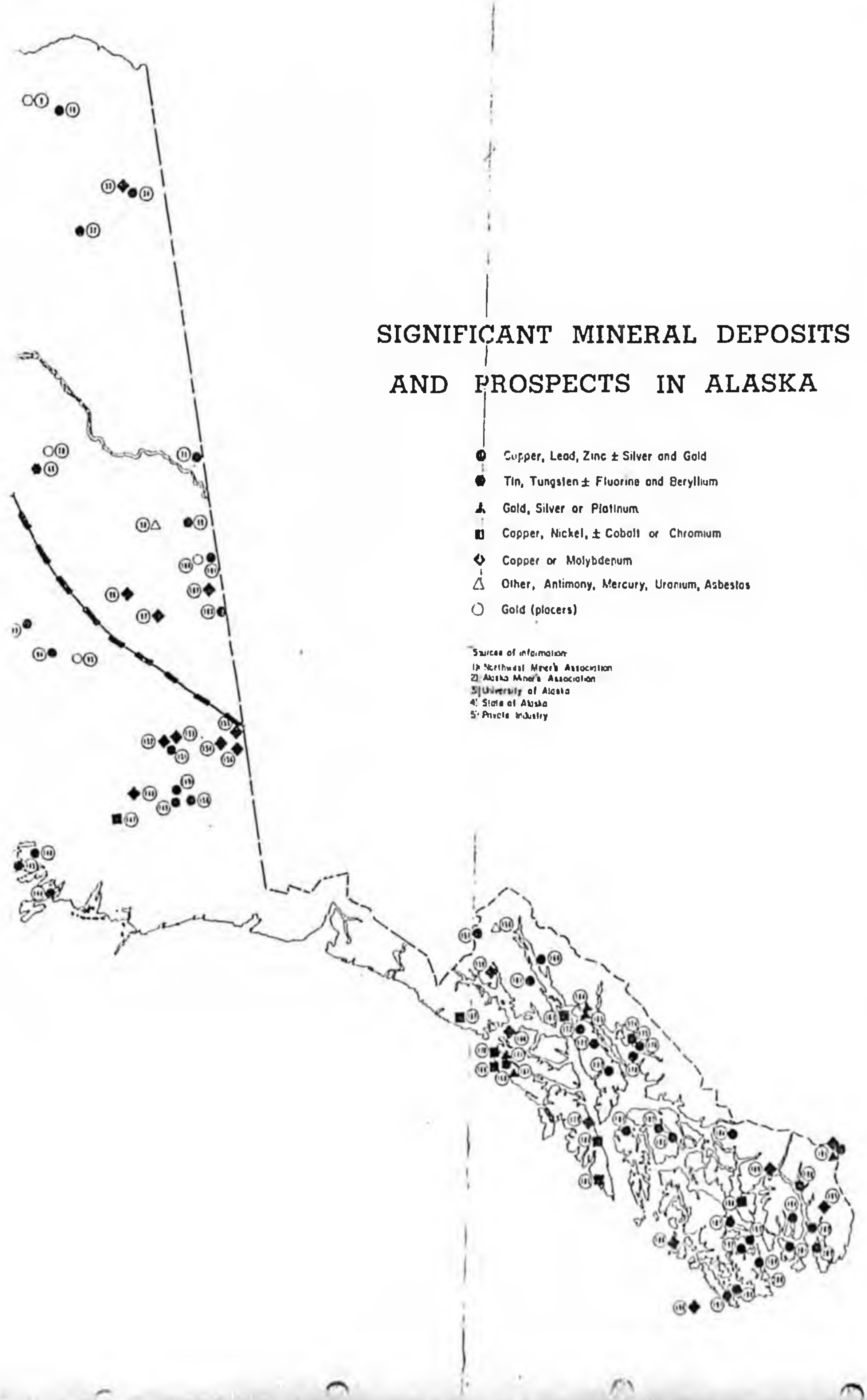
PLATE 1

SIGNIFICANT MINERAL DEPOSITS AND PROSPECTS IN ALASKA



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Eolian Deposits

Qe : undifferentiated eolian sand and silt

Q[illegible] loess

Qer : reworked eolian deposits

Qes . dune sand

L[illegible]strine and Marine Deposits

Ql : undifferentiated lacustrine deposits

Qlb : lake beach deposits

Qld : fan-delta deposits

Qtl : thaw-lake deposits

Qmb : marine beach deposits

Qme : estuarine deposits

Qml : deltaic and lagoonal deposits

Glacial Deposits

Qd : undifferentiated drift

Qo : outwash/inwash

Qis : ice-stagnation deposits

Other Surficial Deposits

Qs : swamp deposits

Qu : undifferentiated surficial deposits

BEDROCK

Igneous Rocks

Big : granitic rocks, coarse-grained gneiss, migmatite

Biv : volcanic rocks

Biu : undifferentiated igneous rocks

Sedimentary Rocks

Bsa : sandstone

Bsc : conglomerate

Bsch: chert

Bsh : shale

Bsi : siltstone

Bsl : limestone, dolostone

Bsu : undifferentiated sedimentary rocks

Metamorphic Rocks

Bmg : greenstone

Bmm : marble, dolostone

Bmq : quartzite

Bms : schist, serpentine

Bmu : undifferentiated metamorphic rocks

Other Bedrock

Bu : undifferentiated or unknown bedrock

metamorphic equivalents
May be deeply weathered

BM : Medium-jointed, fine- to medium-grained quartzose sedimentary rocks and their metamorphic equivalents
May be deeply weathered

BO : All other lithologies
May be deeply weathered

BU : Undifferentiated bedrock lithologies
May be deeply weathered

EXPLANATION FOR ROADS AND CORRIDORS

Existing Road

Proposed Transportation Corridors

Generation 1 Corridors

Generation 2 Corridors

Generation 3 Corridors

DRAFT

Department of Natural Resources
Division of Geological and Geophysical Surveys
Geologic Data Modeling System

Map projection: Alber's Equal Area