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ALASKA COAL FIELDS AND SEAMS

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INTRODUCTION

Alaska's total coal resources are estimated at between 5.5 and 6.0 trillion short tons and probably constitute the most important asset in Alaska's energy future. Coal is found in most physiographic regions of the state (Figure 1), and geologic formations containing coal deposits are thought to underlie about 8.5 percent of Alaska's land area. Coal is known to occur in over half of the 153 quarter-million scale quadrangles of Alaska. The total energy (Btu) equivalency of the coal in Alaska surmounts by many magnitudes that present in all the oil that ultimately will flow from the state.

Coal is known to have been mined in Alaska by the Russians at Port Graham on the Kenai Peninsula beginning in 1855. Small-scale mining has been recorded at many sites throughout the state since then. However, mining did not begin on a significant scale until around 1917 after construction of the Alaska Railroad had begun; for the first time, over a quarter-million tons of coal were produced (Figure 2). Annual coal production in Alaska peaked in 1966 at over 927,000 tons. During the era beginning with World War I and extending up to the present time, coal has been mined mainly in the Nenana and Matanuska coal fields.

All of Alaska's post-1970 coal production and much of the State's production prior to 1970 is accounted for by that of the Usibelli Coal Mine and other operations in the western Nenana basin. About one-third of the 32-million-short-ton Alaska production is estimated to have been mined in the Healy Creek field of the Nenana basin. Another third has been produced on Lignite (Hoseanna) Creek of the Nenana basin. The remaining third was produced in the Matanuska Valley (about 7.5 million short tons) and elsewhere in Alaska.

Early coal production (pre-World War II) in Alaska was dominated by underground mining. An era of combined underground and surface mining followed from around 1943 till the early 1960's. Recent production has been entirely by surface mining (Figure 2). The Usibelli Coal Mine of the Lignite Creek field is currently the only operating coal mine in Alaska. The mine produced about

850,000 short tons in 1984 and is expected to produce about 1.4 million short tons in 1985 (an increase of about 40 percent in one year).

The conversion to less expensive petroleum resources by military installations in the Anchorage area in 1968 initiated a decline of the in-State coal market. However, an expected increased demand for inexpensive, strippable, low-sulfur coal for mine-mouth power plants across the state and for export to Pacific-rim nations has revitalized interest in Alaska's vast coal resources, and will be the key factor in opening up some of the more remote coal basins for future mining. In fact, coal mining in Alaska is projected to increase rapidly the remainder of this century. The International Energy Agency in 1985 projected that Alaska's total coal production in the year 2000 will be over 25 million metric tons.

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COAL RESOURCES

Alaska probably contains half of the coal resources of the United States. The estimated total coal resources in Alaska are between 5.5 and 6.0 trillion short tons. The total identified Alaska coal resources are nearly 170 billion short tons. A large

percentage of Alaska's coal underlies the 23 million acre National Petroleum Reserve on the North Slope. The Northern coal field of Alaska is the largest in the United States, and including offshore extensions is probably the largest in the world in total energy (Btu) equivalency.

New discoveries of coal in Alaska are being made annually as exploration activity steps up. Coal may underlie large areas of the Yukon Flats Cenozoic basin (Barker, 1981), deposits along the Nenana trend have been extended up to 200 miles southwestward (including an estimated 1.5 billion tons of coal at Little Tonzona River), deposits on the Seward Peninsula are being further defined, and significant deposits are also believed to underlie tracts in the Copper River basin. Since the surficial expression of existent coal deposits in many areas of Alaska known to contain large quantities of coal is poor to absent, and considering the relative low level of exploration in the past, entire new fields are likely to be discovered in the future.

COAL QUALITY

Alaska's coal resources range in rank from lignite to anthracite, but the majority are bituminous (55 percent) and subbituminous (40 percent). About 5 percent of Alaska's coal is lignite, but probably half of the subbituminous coal is near the lower end of the subbituminous range (McGee and Emmel, 1979). Anthracite makes up less than 1 percent of total resources and is found chiefly in the Bering River and Matanuska fields. The quality of Alaskan coals in general compares very favorably with other western U.S. coals. One of the chief advantages of Alaskan coals is their extremely low sulfur contents. Organic sulfur is commonly the most abundant form of sulfur in Alaskan coals. Since most acid-mine drainage (AMD) results from pyritic sulfur (particularly framboidal pyrite), both the low sulfur content and organic variety should preclude significant AMD problems at Alaska coal mine sites. The lower mean annual temperatures and local relative aridity act to reduce the oxidation effects on Alaskan coals. During combustion, Alaskan coals are generally characterized by very low emissions of SO_x and NO_x gases.

ECONOMICS

In addition to the vast resource base and wide distribution, the extremely low sulfur contents and near proximity to coastal access in certain areas are important selling points for Alaska coal. In fact, coal-bearing areas in Alaska near tidewater may have the greatest potential of any undeveloped coal 'property' in the United States. Exploration, technology, and economics will ultimately determine the marketability of Alaska's coal resources. Large-scale exploration programs have been conducted in most of Alaska's coal fields for the past decade by private industry and state and federal governments. Alaska's complicated land status may slow or limit future coal development in certain areas.

Technologically, the mining of coals in areas of the state underlain by permafrost may present a formidable future challenge. From an economics standpoint, Pacific-rim countries are potential markets for large-scale coal exports. Alaska is closer to these markets that other possible coal-exporting countries---as Canada, Australia, or South Africa---giving the state a competitive edge. A round trip between Alaska and South Korea requires a total time of 36 days (26 days cruising) versus 45 days between Australia and South Korea. However, because ocean freight rates are very competitive today ($6/ton versus $27/ton in 1980), this advantage may not be as significant as it might first appear.

Test shipments of Alaska coal to Japanese and Korean utilities have been made in hopes of establishing long-term contracts. Production at the Usibelli Coal Mine in the interior increased to about 1.4 million short tons (about 580 million short tons exported) in 1985 in order to meet the terms of the first Asian contract for Alaska coal. In addition to exports, Alaskan coals can be substituted for expensive and uncertain supplies of fuel oil in many Alaskan towns and villages. Mine-mouth power plants and the generation of synthetic fuels (as methanol) are other viable options.

MAJOR COAL FIELDS OF ALASKA

NORTHERN ALASKA FIELDS

The northern Alaska coal fields form by far the largest coal-resource province of the nation in terms of area and resource base.

The deposits, which underlie large areas of the North Slope of Alaska, can be divided into two subprovinces. A largely bituminous subprovince lies to the south near the north flank of the Brooks Range and a wide belt of predominantly subbituminous coals lies farther north. These coals occur in the Corwin, Chandler, and Niakogon Formations of the Nanushuk Group (Early to Late Cretaceous age) and Prince Creek Formation of the Colville Group (Late Cretaceous age). Although seams less than 5-ft thick are characteristic, beds 15- to 40-ft thick are not uncommon. The geologic structure is generally flat-lying to gently dipping.

Identified resources are 150 billion short tons, but hypothetical resources are 4 trillion short tons. Past production has been less than 100,000 tons. The deposits are amenable to either surface or underground mining. Although much of the coal is on federal land of the National Petroleum Reserve Alaska (NPRA), significant deposits exist both east and west of NPRA. In addition to the Cretaceous coals, Mississippian-aged coals of the Kekiktuk Formation and Tertiary coals of the Sagavanirktok Formation are found in northeast Alaska.

LISBURNE (POINT HOPE) FIELD

Mississippian coals of the Lisburne field are among the oldest in Alaska. The coal-bearing unit occurs within the Kapaloak Formation of the Lisburne Group, and extends north-south for about 40 miles from Cape Dyer to Cape Thompson. The field occupies an area of about 200 mi^2, and coal seams are less than 6-ft thick. The geologic structure is fairly complex with many beds deformed and broken by faulting. The coals range from low-volatile bituminous to semianthracite.

No resource estimates have been made for the coal field, but several coal prospects and sites of minor coal extraction exist. Mining is unlikely in the near future but the deposits are more amenable to surface methods.

KOBUK FIELD

Coals of the Kobuk field of northern Alaska occur in the upper member of the Bergman Group (Middle Cretaceous). Coal-

bearing strata of the field generally exhibit shallow dips (less 30°) defining broad open folds, but locally are steeply dipping near high-angle faults. Bituminous coal seams are typically 2-ft or less in thickness.

No resource estimate has been made for the field. A small amount of coal has been extracted in the past for use by placer-gold miners. Future mining potential in the field is low.

CHICAGO CREEK (KUGRUK RIVER) FIELD

The Chicago Creek field lies on the Seward Peninsula and occupies an area of less than 40 mi^2. The lignite coals are of Late Tertiary age and one bed is about 80-ft thick. The seams dip from 45° to 70° and occur in a very narrow graben.

Identified resources are 3.5 million short tons and hypothetical resources are 10 million short tons. Past production amounts to about 110,000 tons. Considering the low rank of the coal, probable future development would be by surface mining.

NULATO FIELD

The Nulato field occurs in an area along the lower Yukon River of western Alaska, and may underlie up to 150 mi^2. Outcrops are common on the north and west bank of the river from Ruby to Anvik. The deposits are found in the Late Cretaceous Kaltag Formation. The coal beds are of bituminous to subbituminous rank and are less than 4-ft thick. The geologic structure in the region is locally complex with folding and faulting of coal beds.

Hypothetical resources are estimated at 50 million short tons. Past production has been less than 5,000 tons. Future mining potential is low.

RAMPART FIELD

Scattered outcrops of the Rampart field occur over an estimated area of about 100 mi^2 in the interior of Alaska. The Early Tertiary coal-bearing unit is exposed along the middle reaches of the Yukon River and near its confluence with the Tanana River

in the vicinity of Rampart. The coal beds are of subbituminous to bituminous rank, typically less than 5-ft thick, and steeply dipping.

Hypothetical resources are estimated to be 50 million short tons. Past production has been less than 5,000 tons. Further exploration will be required in this region to determine future mining potential.

EAGLE FIELD

Late Cretaceous to Tertiary subbituminous to bituminous coals of the Eagle field occur along an 80-mile stretch of the upper Yukon River in eastern interior Alaska. Scattered outcrops within the field are found over an area of nearly 800 mi^2. Coal seams are typically less 5-ft thick. Broad open folds characterize the geologic structure of the coal-bearing unit.

Identified resources are estimated at 10 million short tons, and hypothetical resources are estimated at 100 million short tons. The field includes several coal prospects and sites of minor coal extraction, including less 2,000 tons mined on Nation River. Future coal mining potential in the region is low.

NENANA FIELD

The Nenana field forms the third largest coal-resource base in Alaska. Outcrops of the Tertiary coal-bearing group are spread over an area encompassing nearly 1,000 mi^2. The deposits trend east-west along the north-central flank of the Alaska Range for about 140 miles. The important coal-field subdivisions include Western Nenana (Teklanika), Healy Creek, Lignite Creek, Rex Creek, Tatlanika Creek, Mystic Creek, Wood River, West Delta, East Delta, and Jarvis Creek fields.

Essentially all of Alaska's coal production today comes from the Nenana field near Healy. The approximately 3,000-ft thick coal-bearing sedimentary sequence rests directly on Precambrian and Paleozoic metamorphic rocks. The Suntrana Formation contains the bulk of the coal resources of the field. The Usibelli Coal Mine at Poker Flats in the lower Lignite Creek field currently is mining

the Nos. 3, 4, and 6 seams, which average about 20-ft thick each. Coal seams in the Nenana field range up to 60-ft thick. Moderately-dipping fault blocks and gentle folds are the predominant geologic structures.

Identified resources of the Nenana field are 8 billion short tons and hypothetical resources are estimated at 20 billion short tons. Past production has been over 20 million tons, the highest for any field in the state. Although the deposits are more amenable to surface-mining methods, underground mining may also be possible on certain tracts.

JARVIS CREEK FIELD

The Jarvis Creek field occurs east of the Delta River at the easternmost extent of the Nenana trend. The field encompasses an area less than 40 mi^2. The Tertiary sedimentary sequence here probably correlates with the lower part of the coal-bearing group, at least in part the Healy Creek Formation. The coal beds are less than 10-ft thick and are of subbituminous rank. They dip gently around the rim of this relatively isolated structural basin.

Identified resources are estimated at 75 million short tons, and hypothetical resources are estimated at 175 million short tons. The deposits are amenable to surface mining.

FAREWELL (LITTLE TONZONA) FIELD

The Farewell coal field occurs near the southeastern margin of the Minchumina basin in southwestern Alaska and contains outcrops scattered over an area of about 200 mi^2 from Little Tonzona River to the Middle Fork of the Kuskokwim River. The Tertiary coal-bearing sequence at Little Tonzona River includes one seam over 100-ft thick. Seams at Deepbank Creek range from 5- to 20-ft thick. The coal is predominantly of subbituminous rank, and occurs in low-angle fault blocks and minor folds. Coal on Cheeneetnuk River at the west end of the field is marginal bituminous.

Total estimated identified resources are 1.5 billion tons. There has been no significant past production in the field. Probable future development will be by surface mining.

BROAD PASS FIELD

The Broad Pass field occurs in south-central Alaska and is considered to be a northeastern extension of the Cook Inlet basin. The field includes the deposits in the vicinity of Broad Pass Station and on Costello Creek. The Tertiary coal-bearing sequence at Broad Pass occupies a narrow graben less than 40 mi^2 in area; the coals are lignites and range from 5- to 10-ft thick. The Costello Creek basin coals occur in an area less than 10 mi^2 and are of subbituminous rank.

Identified resources are estimated at 50 million short tons, and hypothetical resources are estimated at 500 million short tons. Past production has been less than 100,000 tons. The deposits are amenable to surface mining.

BELUGA AND YENTNA FIELDS

The Beluga and Yentna fields occur in the Susitna lowland of south-central Alaska, and contain the largest reserves of coal recoverable by surface mining in southern Alaska. Coal-bearing outcrops of the Tertiary Kenai Group are scattered over a broad area incorporating nearly 6,000 mi^2. Most of the major minable seams (over 20-ft thick) of the Kenai Group are restricted to the Tyonek Formation, while thinner subbituminous and lignite coal beds occur in the Beluga and Sterling Formations. The coal-bearing strata are relatively flat-lying, but broad gentle folds and minor faults are found locally. Seams over 50-ft thick may have less than 150 ft of overburden. Coals of the Chuitna River area include the Brown, Yellow, Green, Blue, Red, and Purple seams (Figure 3). The Capps area is a localized coal deposit of the Beluga field occupying an area less than 10 mi^2. Two major beds, the Capps and Waterfall seams of 55- and 25-ft maximum thickness (respectively) occur within this deposit.

Identified resources of the two fields are estimated at 10 billion short tons, and hypothetical resources are estimated at 30 billion short tons. The fields include several coal prospects and sites of minor coal extraction.

LITTLE SUSITNA FIELD

Coal beds of the Little Susitna field occur in Tertiary Kenai Group strata that are moderately to gently dipping and slightly folded. Most of the subbituminous coal beds are too thin (less 2-ft) to be considered minable, but a few seams ranging from 2.5- to 10-ft occur at depths less 1,000 ft.

Hypothetical resources of the field are estimated at 10 million short tons. Past production has been less 100,000 tons. Future mining potential is low.

MATANUSKA FIELD

The Tertiary Chickaloon Formation of the Matanuska field contains at least 30 separate coal beds in the upper third of the 5,000-ft thick unit. Coal-bearing outcrops are scattered over an area of about 700 mi^2 in south-central Alaska, and are found in three main districts---Wishbone Hill, Chickaloon, and Anthracite Ridge. The main field subdivisions include Eska-Moose (Wishbone Hill), Young Creek, Castle Mountain, Chickaloon, and Anthracite Ridge. The seams in the Wishbone Hill area occur in the Jonesville, Premier, Eska, and Burning Bed coal groups. Some coals of the Chickaloon area are of coking quality. Coals along the south flank of Anthracite Ridge have been upgraded to semianthracite and anthracite because of contact metamorphism by igneous intrusions and regional deformation. The coals of the region range in thickness from 2 to 40 ft.

Identified resources are estimated to be 180 million short tons, and hypothetical resources are estimated at 500 million short tons. Past production has been about 7.5 million tons, the second highest of any field in Alaska. Although the resources of the Matanuska field are mainly underground, recent exploration work has defined certain tracts which should sustain surface mining for the first 20 to 40 years of any new development in the field.

KENAI FIELD

Tertiary coal-bearing rocks of the Kenai Group underlie much of the Kenai Peninsula and extend offshore beneath Cook Inlet. The landward portion of the field alone occupies an area over 2,000 mi^2.

The coals occur mainly in the Beluga and Sterling Formations, but Tyonek Formation strata are found at depth in oil wells. The coals are mainly of subbituminous rank and range from 2.5- to 20-ft thick. The coal-bearing strata are predominantly flat-lying to gently dipping.

Identified resources (onshore only) are estimated to be 320 million short tons, and hypothetical resources (onshore only) are estimated at 35 billion short tons. Past production has been less than 100,000 tons. Although the deposits are more amenable to surface mining, underground mining may also be possible locally.

COPPER RIVER FIELD

Coals of the Copper River field of southcentral Alaska occur in the Tertiary Frederika Formation. Numerous lignite beds to 18-ft thick are found in isolated fault blocks, prisms, and erosional remnants.

No resource estimates have been made for this field, there has been no past production, and future mining potential is probably low.

BERING RIVER FIELD

The distribution of the coal deposits of the Bering River field of south-central Alaska is delineated by the outcrop extent of the Kushtaka Formation. The area of the field is nearly 300 mi^2. In general, the coals increase in rank from the western part of the field to the eastern part; most are high-grade bituminous and anthracite. The structure of the Tertiary coal-bearing formation is complex with the coals occurring in pod- or lense-shaped thickenings from 6- to 30-ft thick.

Identified resources are estimated at 100 million short tons, and hypothetical resources are estimated at 3.5 billion short tons. Although there are numerous surface and underground prospects, no commercial mines have been developed. Past production has been less than 100,000 tons. Despite the complex structure, exploration in the field has been intense because of the high coal quality. Future development may be by surface or underground mining methods.

KOOTZNAHOO INLET (ANGOON) FIELD

Tertiary coal-bearing strata of the Kootznahoo Inlet field are moderately deformed and faulted but locally only gently folded and nearly horizontal. Bituminous coal seams are generally less 3-ft thick.

No resource estimate has been made for the field. Past production has been less 1,000 tons. Future mining potential is low.

CHIGNIK AND HERENDEEN BAY FIELDS

The Chignik and Herendeen Bay fields occur on the Alaska Peninsula. Late Cretaceous bituminous and subbituminous coals of the Chignik field occupy an area over 150 mi^2. Coals of the Coal Valley Member of the Chignik Formation are typically less than 9-ft thick. Late Cretaceous bituminous and Tertiary subbituminous coals of the Herendeen Bay field occupy an area over 1100 mi^2. At Mine Harbor on Herendeen Bay, up to 17 coal beds crop out but most are less than 2-ft thick. The strata in both fields are moderately folded and faulted.

Identified resources of the two fields are 200 million short tons, and hypothetical resources are estimated at 3 billion short tons. Past production has been less than 100,000 tons. The deposits may be amenable to either surface or underground small-scale mining.

UNGA ISLAND FIELD

Lignitic coal deposits on the northwest peninsula of Unga Island occur in an area less than 40 mi^2. The coals are found in the Tertiary Unga Conglomerate Member of the Bear Lake Formation. Beds are typically less than 3-ft thick. Identified coal resources in seams over 1.5-ft thick are estimated at 70 million short tons. Future small-scale mining for local use may be feasible in this field.

RECENT COAL ACTIVITY IN ALASKA

ALASKA COAL EXPORTS

Alaska coal exports in 1985 included 9 shipments of 60,000 to 70,000 metric tons each totaling about 540,000 metric tons for the year. Two additional shipments of about 120,000 metric

tons scheduled for late December were not completed because of the fire that temporarily curtailed production at the Usibelli Coal Mine.

Several factors in 1985 tended to make Alaskan coal less competitive than coals from other major Pacific-rim exporting countries. The Canadians and Australians dropped their prices such that a price differential of 15 percent developed between Alaskan and Canadian coal and of 25 percent between Alaskan and Australian coal. And although the value of the U.S. dollar fell respective to the currencies of several nations, it did not drop substantially relative to the Canadian and Australian dollars.

These combined economic factors have forced the Korea Electric Power Corporation (KEPCO) to reduce the base volume of coal to be purchased by 20 percent. In the original contract between Usibelli Coal Mine, Suneel Alaska Corporation, Sun Eel Shipping Co., Ltd., and KEPCO, provisions allowed for 'fixed' base prices and indices to vary. The price could then be adjusted from one tier to another based on current economic conditions. Thus, Alaska coal exports in 1986 are expected to total about 640,000 metric tons, down from earlier projections of 800,000 metric tons.

Technically, the export of Alaska coal has proven that it transports well and is suitable for boiler use. The coal arrives in Korea in roughly the same form it was in leaving Alaska. Coal and ash handling properties are generally favorable compared to Canadian coal. However, Alaskan coal produces 210 megawatts per ton compared to 270 megawatts per ton for coal from Crowsnest, British Columbia, Canada. Spontaneous combustion has not proven to be a critical problem during transport.

SEWARD COAL TERMINAL

The Seward Coal Terminal, Alaska's first deep-water coal port, was completed in late 1984. The transfer facility is located on some 34 acres of Resurrection Bay, southeast coast of Kenai Peninsula. Although its annual maximum design capacity is 3 million metric tons, it will initially handle 800,000 metric tons of coal(±)

per year from the Usibelli Coal Mine at Healy. In 1985, the facility handled about 540,000 metric tons; it filled about one ship per month on average. The Seward Coal Terminal is owned and operated by Suneel Alaska Corporation, a subsidiary of Sun Eel Shipping Co., Ltd.

At Seward, the coal is onloaded to a 60,000 ton ship (Figure 4) of Hyundai Merchant Marine for ocean transport to Samchonpo, Korea. There it is unloaded and transported by barge to Honam. The coal is used in Korea Electric Power Corporation's Honam Power Plant, a 1,000-megawatt plant located on the southern tip of South Korea (Usibelli Coal Mine, 1984).

The major components of the terminal facility at Seward include: 1) a new railroad spur; 2) a receiving hopper system; 3) an extensive belt conveyor system; 4) junction towers; 5) rail shakers; 6) a stacker/reclaimer referred to as the 'Big Dipper'; 7) a dust collection system; 8) stockpile water sprayer/fire fighting system; 9) operations control building; 10) 1,800 ft of dock trestle system; 11) a dock to support an elevated shiploader; and 12) various marine breasting and mooring dolphins (Suneel Alaska Corporation, 1985).

The port can accomodate vessels to 120,000 dwt and with a maximum draft of 58 ft. The facility is capable of loading 1,000 metric tons of coal per hour, or a 60,000 ton ship in three days. Its annual capacity is rated at 3 million metric tons. The coal stockpile maintained onsite has a capacity of 120,000 metric tons. The 'Big Dipper' has a stacking capacity of 3,000 metric tons per hour and a reclaiming capacity of 1,000 metric tons per hour.

ALASKA RAILROAD

The Alaska Railroad was purchased by the State of Alaska from the Federal government on January 5, 1985. The Alaska Railroad Transfer Act was finalized at a $22 million purchase price. The Alaska Railroad transported coal for its first 70 years under Federal control. The first load of coal arrived in Anchorage on August 17, 1916, and the railroad has been busy moving coal ever since. At that time, coal sold for $0.25 per ton.

In 1985, the Alaska Railroad carried 114 trainloads of coal averaging 5100 short tons per trip. Five new locomotives (each costing $950,000) and 60 new hopper cars have been purchased and committed exclusively to hauling coal. The Alaska Railroad will be seeking a $230,000 investment from the state in 1986 for docking sonar and line-handling equipment at the Seward port facility.

WESTERN ARCTIC COAL DEVELOPMENT PROJECT

In 1984 the Western Arctic Coal Development Project (WACDP) conducted a reconnaissance drilling program and performed a preliminary economic evaluation of the Cape Beaufort and Deadfall Syncline areas of the Western Arctic. In 1985 the Arctic Slope Regional Corporation (ASRC) conducted a pre-development drilling and geophysical program at the Deadfall Syncline area. Howard Grey and Associates Inc. served as field contractor for both the 1984 and 1985 programs. The WACDP also performed mine, infrastructure, environmental, and village end-use feasibility studies in 1985.

Howard Grey and Associates, under contract to Arctic Slope Consulting Engineers* drilled a total of 74 holes at Cape Beaufort (27 holes to 150-ft deep) and Deadfall Syncline (47 holes to 110-ft deep). A Nodwell-mounted Simco 2800 HS Drill was used to drill all holes. The major objective of the drilling program was to provide critical input into the selection of a preferred mine site for further study. As part of the site selection process, the data gathered from the drilling program was evaluated along with technical, environmental, and social conditions to determine the preferred site. The Deadfall Syncline area was ultimately selected as the preferred site.

At Cape Beaufort, 26 seams were identified but only 4 were considered minable. Strippable coal was estimated at 22.4 million tons and the total potential reserve was estimated to be 25 million tons. The Deadfall Syncline area held higher quality coal (12,200 Btu/lb and 0.1-0.3 percent sulfur) in seven minable seams. Strippable coal was estimated at 15.8 million tons but the total

*Arctic Slope Consulting Engineers (ASCE) was formed as a wholly-owned subsidiary of the Arctic Slope Regional Corporation (ASRC) in 1982 after the dissolution of Arctic Slope Technical Services (ASTS). ASTS was a partially-owned subsidiary of the Arctic Slope Regional Corporation from 1977 to 1982.

potential reserve was estimated to be 59 million tons.

The Deadfall Syncline would be developed for local use in western Alaska and would be mined seasonally for 75 to 108 days at an initial production of 20,000 tons per year. The total market of the western coast of Alaska is estimated at 300,000 to 500,000 tons per year. Possible specific markets include the Red Dog and Lik (zinc-lead-silver) mine developments. Red Dog is located about 90 road miles from the Deadfall Syncline area, and the Lik deposit is about 12 miles from Red Dog.

MORGAN COAL COMPANY

Morgan Coal Company holds a prospecting permit that has not matured into a lease with the U.S. Bureau of Land Management. The area is located on the Kukpowruk River in northwest Alaska. The Arctic Slope Regional Corporation selected the same tracts of land under the Alaska Native Claims Settlement Act of 1971. Morgan Coal Company continues to pursue a lease and until this issue is resolved, the land in question cannot be transferred from the Federal government to the Arctic Slope Regional Corporation. The permit area includes about 5,000 acres in two blocks. Reserves of coking bituminous coal with 2-3 percent ash are estimated to last at least 10 years at the projected mining rate of 1 million tons per year.

USIBELLI COAL MINE

The Usibelli Coal Mine Inc. (UCM), located near Healy in interior Alaska, set a new all-time Alaska coal production record in 1985 at 1.4 million short tons. It surpassed the previous one-year production total of 927,000 short tons in 1966 and exceeded its 1984 production total of 850,000 short tons by 40 percent.

The production would have been higher in 1985 except for a serious fire on November 18 that reduced year-end tonnages. The fire temporarily curtailed exports but did not affect the mine's customers in interior Alaska. The fire began at the base of the cam span on the conveyor system that carries coal across the Nenana River between the east and west sides of the mine's

new tipple complex. The entire cam span was destroyed but the east and west tipple facilities were little damaged. Total damage was estimated at $500,000. Mine officials stated that it would take five or six months to receive the cam section and get the tipple operational again.

On other matters, UCM completed about a third of the 7.8 miles of new haul road it is constructing up Lignite Creek that will eventually connect Poker Flats (Figure 5) and Gold Run Pass mine pits. The company was also granted an exemption from stockpiling and redistributing topsoil by the Alaska Division of Mining based on its past revegetation success using overburden materials as a plant-growth medium.

DELTA COAL COMPANY

The Delta Coal Company (DCC) received the last preference right lease granted by the U.S. Bureau of Land Management (BLM) on April 1, 1983. The 2500-acre lease is located in the Jarvis Creek field on the north-central flank of the Alaska Range in the interior. It is south of Delta Junction and 18 miles from Ft. Greely military reservation. The lease is connected to the Richardson Highway by a 7-mile long graveled access road.

The area of the Jarvis Creek field is about 16,000 acres. Coal from the field has been actively produced for small local markets in the Big Delta and Fairbanks areas since its discovery in the mid-1950's (Figure 6). In 1969-1970, a small mine operated in the field to produce coal for all the schools in the Fairbanks North Star Borough that used coal for heat.

The coals of the Jarvis Creek field are of subbituminous C rank, averaging 17 percent moisture, 10 percent ash, and 1 percent sulfur. Pit-run coal averages 8750 Btu/lb, air-dried coal 9570 Btu/lb, moisture-free coal 11000 Btu/lb, and moisture- and ash-free coal 12430 Btu/lb.

DCC estimates geological coal resources of the field at 150 million tons and proven reserves at 1 million ton. There are not enough reserves in the field to support major infrastructure development. DCC will mine a 3-m thick seam at a stripping ratio of 1:1. The company's mining plan calls for the production of 50,000 tons of coal per year over a 20-year mine life.

DCC completed an environmental impact statement in 1983, and by 1985 had completed a drilling and testing program to determine the scope of proven reserves. The company estimates that its permit process initiated with the BLM should be finalized by April 1986.

The Federal Defense Agency announced in 1984 its plan to convert the Ft. Greely power facility from oil to coal generation. This facility was one of four military installations nationwide slated to be converted. A study by Ebasco Services and Georgetown University in 1985 recommended the construction of a combination coal gasification fuel cell power plant facility to supply electricity to the Ft. Greely and Big Delta areas. The proposed 7.5-megawatt plant would be located on the military base and would cost in the $40 million range.

Other possible markets for the Jarvis Creek coal include: 1) a plan being considered by the Copper River Valley Cooperative in Glennallen to convert its oil-fired power plant to coal; 2) use in processing interior Alaska grains; and 3) use in developing a nearby limestone quarry; and/or 4) use in developing precious and base metal massive sulfide deposits in the vicinity.

BELUGA COAL COMPANY

The Beluga Coal Company (BCC), a subsidiary of Placer U.S. Inc., in cooperation with the Cook Inlet Region Inc. (CIRI) holds coal rights to some 26,926 acres (17,686 from the State and 9,240 acres of CIRI land) in the Beluga field of south-central Alaska. The leases are divided into three separate blocks---Capps, Chuitna, and Threemile deposits, which are 25, 15, and 8 miles respectively northwest of the village of Tyonek. BCC estimates that its leases hold 1-billion tons of subbituminous C coal reserves, of which half is surface-minable by conventional methods. The coal averages 7500 Btu/lb, 25 percent moisture, less 0.2 percent sulfur, and stores and transports well.

Beluga Coal Company plans to initially develop a small tonnage (1.0 to 1.5 million metric tons per year) operation using ships in the 40,000 dwt range that can use the existing 1475-ft pier and dock facilities at North Foreland west of Tyonek village.

A full review of the 1.0 million metric ton operation has been completed that indicates start-up capital costs at $33 million for a 20-year mine life. The company has estimated the coal price FOB ship at Cook Inlet to be $24 per metric ton. A review of the 1.5 million metric ton per year operation preliminarily indicates this to be a more economic size, but will require an extension to the existing dock at North Foreland to permit coal carriers in the 60,000 to 70,000 ton (dwt) range to berth.

The mine site will be located about 21 miles from the North Foreland pier. In 1984 BCC established routing plans for haul roads and identified borrow pits. A 6-mile haul-road extension will connect the mine site with an existing 15-mile section of logging road. Four miles of this access road to the Center Ridge tract was built in 1985. The haul road is being designed for 50-ton end-dump trucks that will carry the coal to a crusher near North Foreland. The crushed coal will be stockpiled and later reclaimed and moved by conveyor to a traveling shiploader on the end of the pier.

BCC completed a compilation of its environmental data and obtained right-of-way, stream crossing, and wetland permits during 1985. BCC has met with the Electric Power Development Corporation and Nissho Iwai Corporation of Japan to examine means of developing and marketing its Beluga coal.

DIAMOND ALASKA COAL COMPANY

Diamond Alaska Coal Company (DACC), a subsidiary of Dallas-based Diamond Shamrock Corporation, controls State leases in the Beluga field between the leases of Placer U.S. Inc. The tracts, which are located 12 miles from tidewater, are bounded by the Chuitna River on the south and west and Lone Creek to the east and north.

The DACC mine will be the largest coal-development project in the state and will include eight major components---the mine, mine service area, worker housing, airport, water supply, power generation, overland transportation, and port. The mine will require a $600 million capital investment for facilities and infra-

structure. DACC plans to initially produce 2-3 million tons of coal per year rising to 12 million tons per year within 4 years after start-up. The open-pit mine will employ two draglines for overburden stripping and will develop 5 seams between 6- and 20-ft thick (Figure 3). A primary crusher will be located in front of the advancing mine face. A conveyor will move the coal 13000-ft to a secondary crusher at the mine service area. The complete conveyor system will be 11-miles long.

DACC estimates that its Beluga leases hold 1 billion tons of subbituminous coal characterized by low grindability, low Btu value, low sulfur, high moisture, and good ash-handling qualities. Bulk-coal sampling and testing programs were completed in 1983 (Figure 7). The lease area has been divided into three logical mining units. The first area (mining block no. 1) has an estimated 330 million short tons of recoverable reserves over a projected mine life of 34 years.

Dames and Moore prepared the environmental impact statement for the proposed DACC mine scheduled to become operational in 1989. DACC anticipates having a fully-permitted operation around April 1 to July 1, 1986. The company completed geotechnical, bathymmetric, current, and tidal studies in Cook Inlet during 1985 spending over $1 million offshore. DACC drilled 17 holes off Granite Point in Cook Inlet each 60- to 80-ft below mudline. The floor of the inlet was found to be hard, and the studies confirmed that Granite Point is the best location for the pier. The data produced by the drilling project will be used to complete the geotechnical design of the trestle to be constructed. The Cook Inlet drilling project concluded the preliminary data-gathering for the project and allows the preparation of detailed operating plans for the mine.

The Kenai Peninsula Borough announced in 1985 that it will provide easement on the west side of Cook Inlet at Granite Point for the development of a multi-use public port facility. The port, which is to be owned by the borough, will require $250 million in financing and bonding. Bonds were scheduled to be sold in December 1985 and port construction set to begin in 1986. The on-shore port complex will occupy 300 acres, and the

off-shore facilities will include the construction of a pile-supported conveyor belt trestle and shiploader projecting more than two miles into the inlet. The conveyor will carry coal to ships berthed at the pier. The facility will be able to load ships to 120,000 dwt with coal bound for Pacific-rim nations.

DACC and Japan's Electric Power Development Corporation (EPDC) entered a joint feasibility study in September 1984 to test Beluga coal in Japanese power plants. The EPDC study was slated to be published in December 1985, and DACC expected the study to show that its Beluga coal was competitive considering all its aspects. DACC is also seeking sale commitments from utilities in South Korea and Taiwan, and anticipates positive marketing news in 1986. If that proves to be the case, they expect to begin construction in 1987, and to ship coal by 1990.

MOBIL ALTERNATIVE ENERGY INC.

Mobil Alternative Energy Inc. (MAE) holds leases to 23,080 acres in two major blocks (Canyon Creek and Johnson Creek areas) about 55 miles northwest of Tyonek in the Yentna field. The coal leases were issued by the state in 1979. MAE has put its drilling, mine design, and reserve evaluation on hold until the energy industry stabilizes. In addition, MAE has dropped their option on the Meadowlark Farms leases (tracts including 3880 acres located on Friday and Saturday Creeks about 45 miles northwest of Tyonek) due to poor coal-quality results.

ROCKY MOUNTAIN ENERGY

Rocky Mountain Energy (RME; a Wyoming-based company, subsidiary of Union Pacific Railroad) and Hawley Resource Properties, Inc. (HRP) entered into an exploration agreement in 1983 to determine the economic and technical feasibility of developing a coal mine on four state leases totaling 2,000 acres. These four leases are located in the western half of the Wishbone Hill district of the Matanuska coal field approximately 8 miles northeast of Palmer, Alaska, 10 miles east of the Alaska Railroad, and 60 miles east of Anchorage. RME presently has a 64 percent controlling interest and will be the mine operator.

Exploration programs involving extensive drilling operations (Figure 8) and subsequent preliminary feasibility studies completed in 1983 and 1984 have confirmed a recoverable surface minable reserve of approximately 14 million tons (a 20-year supply of coal at mining rate of 700,000 run-of-mine tons per year). Although concentrating on potentially surface-minable reserves in near future, the long-term potential is greatest for underground development. A coal washery may be necessary to produce an exportable product because of the high ash contents. Through washing, a coal quality of 12,460 Btu per pound (7000 kcal/kg), 0.4 percent sulfur, low sodium, and some coking qualities can be produced. Preliminary mine feasibility studies suggest a small truck/shovel mining operation with an annual production rate of 400,000 to 800,000 tons costing $1.40 per million Btu. Mine associated infrastructure will be minimal and may include 4 to 5 miles of paved highway and a loadout facility on the Alaska Railroad near Palmer.

In December 1984 RME, through Competitive State Coal Lease Sale No. 6, acquired three new lease tracts totaling 5,200 acres located around the periphery of the original four lease tracts. Detailed geologic field mapping conducted in 1985 indicates the new tracts have moderate-to-high potential for containing surface minable coal. The new lease tracts do not hold the tonnage potential of the old leases but exploration indicates a low overburden: coal ratio. RME plans to continue exploration drilling on the new leases to stretch surface-minable reserves to 35-40 years. The seam characteristics appear to be better than on the older leases, and direct shipping coal with a yield of 6500 to 7500 kcal/kg should be obtainable without washing.

RME and HRG have been investigating various export options as well as examining the possibility of an on-site mine-mouth power plant. The mine complex in this case would include four main components: 1) a conventional truck-shovel surface coal mine; 2) a coal handling system to clean, sort, crush, and deliver coal to the power plant; 3) the power plant; and 4) environmental control systems such as stack scrubbers, dust settlement bags and water treatment facilities. Through altering production and coal washing schemes, the product coal quality and cost can be varied.

The large latitude in quality and cost afforded by this coal lends itself to a variety of customer types, both in Alaska and abroad. A preliminary feasibility study of the mine-mouth power plant concept was conducted in 1985 by Signal Energy Systems in cooperation with RME and HRG. The results of this study indicate there is a high probability of feasibility for a power plant and associated mine. An association known as Matanuska Power Project (MPP) was formed to further the power plant concept. This association consists of Signal Energy Systems, RME, HRG, and most recently Cook Inlet Region, Inc.

MPP has already spent $2 million on the power plant concept. The power plant is expected to cost about $410 million and be built and owned in the private sector. About 600 temporary jobs would be created during the construction phase, and eventually would require 200 permanent employees. The power plant designed for a 50-60 year life would come on line in 1991 with a net generating capacity of 150 megawatts. The power generated would be sold to a utility. The Matanuska Electric Association (MEA) based at Palmer may decide to purchase the power from MPP but will have to renegotiate its sole-source wholesale power purchase contract with the Chugach Electric Association of Anchorage. MEA's feasibility studies reveal that the economics of coal is now about the same as the gas option, but will be lower than gas from about the year 2000.

BERING DEVELOPMENT CORPORATION

The Bering Development Corporation (BDC) is a joint venture between Chugach Alaska Corporation and a consortium of Korean firms called the Korea Alaska Development Corporation (KADCO) formed to develop a coal mine in the Bering River field. The proposed mine site is located about 40 air miles southeast of Cordova, 170 air miles southeast of Anchorage, and 27 air miles from the potential port site and oil field at Katalla.

In 1984 BDC drilled approximately 15000 ft in the Monument Mountain and Cochrane Creek areas of Bering River field. During 1985, BDC completed 17,060 ft of exploration drilling, which constituted the bulk of coal drilling in the state. It was the fifth and final year of exploration and essentially completed this phase

of development. The total coal reserve potential is estimated at 60 million tons with 35 million tons believed to be minable. The anthracite and low-volatile bituminous coals are found in five seams, two of which are suitable for surface extraction but three that will require underground mining.

BDC has begun preliminary mine design and cost studies. In the first year, the mine would produce 500,000 tons, later reaching a maximum of 1.5 million tons annually. BDC is expected to begin the environmental impact statement preparation process and 3-year licensing and permitting period in 1986.

The development of a mine-mouth power plant is also under consideration. The proposed system would use a pulverized coal injection burner (PCI) in which fine coal powder is mixed with oil giving a high Btu output. Excess power would be sent to Cordova via a transmission line.

UNIVERSITY OF ALASKA MINERAL INDUSTRY RESEARCH LABORATORY

The Mineral Industry Research Laboratory (MIRL) of the University of Alaska, Fairbanks conducted several programs for the characterization of Alaska coals in 1985. These programs included: 1) research to determine the reactivity and liquefaction potential of Alaska coals; 2) a Department of Energy-sponsored washability study of Alaska coals; 3) research related to the environments of deposition of Alaska coals; 4) palynological research on Alaska coals; and 5) coal analyses for the State DGGS, Hawley Resource Group, and Arctic Slope Consulting Engineers.

MIRL has scheduled its third Alaska Coal Conference (Focus on Alaska's Coal) for November 1986 in Anchorage. A proceedings volume will be published subsequent to the conference.

ALASKA DIVISION OF GEOLOGICAL AND GEOPHYSICAL SURVEYS

The Alaska Division of Geological and Geophysical Surveys (DGGS) has had an ambitious program for the exploration and assessment of Alaska's coal resources for the past five years. This program has included investigations in northwest Alaska (principally at Cape Beaufort, Figure 9), in the Kobuk field, at Koyuk and Unalakleet, in the Chicago Creek field, Point Hope field, and on St. Lawrence Island. Basinal studies have been

been conducted in the Susitna lowland, Nenana basin, Matanuska Valley, and on the Alaska Peninsula (Chignik, Herendeen Bay, and Unga Island fields). The Alaska Peninsula and Chicago Creek projects were ongoing through 1985. At Chicago Creek on the Seward Peninsula (Figure 10), Hawley Resource Group continued a mapping and geophysical-exploration program that has already proven 3.5 million tons of lignite.

The DGGS programs over the past five years have resulted in the production of a number of consultant reports, and of published and unpublished DGGS reports on the coal resources of the areas investigated. Several new reports were added to DGGS's in-house Public Data Files in 1985.

A draft copy of a new Coal resources map of Alaska is now complete after two years of preparation and review. This map is now in cartography and should be printed in 1986.

DGGS has submitted an application to the U.S. Geological Survey for assistance under the COGEOMAP (Cooperative Geologic Mapping) Program for mapping and exploration of the southern Kenai coal field to begin in 1986.

DGGS is also cooperating on two projects in interior Alaska. The first involves an investigation of the Nulato coal field of western Alaska conducted in cooperation with the University of Alaska Mineral Industry Research Laboratory, U.S. Bureau of Mines, and Doyon, Ltd. Initial reconnaissance exploration was carried out during the 1985 field season, and a more extensive program is planned in 1986. The second project is being conducted by DGGS staff in cooperation with the USBM and involves a comprehensive investigation of other coal occurrences of interior Alaska.

In addition, DGGS is working on a proposal that will permit Alaska to join 22 other states that participate in the National Coal Resources Data System (NCRDS). Upon acceptance into this program, federal funding will accrue to the state to support the compilation of coal data into the system.

ALASKA DIVISION OF MINING

The Alaska Division of Mining (DOM) regulates coal mining in the state and is involved in issuing many of the required mining

permits. It administers the Surface Coal Mining Regulatory Program and the Abandoned Mined Land Reclamation Program. The agency is cooperating with the Federal Office of Surface Mining on slope stability, revegetation, and water management problems at abandoned mine sites in Alaska. In 1985, the division was actively working on the coal mine permit application submitted by Diamond Alaska Coal Company.

The Division of Mining is also responsible for leasing State coal lands. Leasing conditions include: 1) payment of annual fee of $3 per acre; 2) granting original award to those bidding the highest 'cash bonus' for the right to explore; 3) posting of a performance bond of $5,000 or $5 per acre; and 4) paying a royalty of 5 percent (reset every 10 years) on the adjusted gross value after mining begins.

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FIGURE CAPTIONS

Figure 1...Alaska's coal fields and isolated coal occurrences.

2...Coal production in Alaska, 1915-1984.

3...Generalized stratigraphic section of the Chuitna River area, Beluga field showing major minable coal seams (courtesy of Diamond Alaska Coal Company).

4...The loading of the collier Vigan at the Seward Coal Terminal, September 1985.

5...'Ace-in-the-Hole' dragline in operation at Usibelli Coal Mine's Poker Flats pit (photo July 1982).

6...Site of former small mine in the Jarvis Creek field and location for planned new development by Delta Coal Company. The 3-m thick main seam (near center of photo) occurs in the Healy Creek Formation.

7...Blue Pit bulk-coal sampling site, Diamond Alaska Coal Company lease, Beluga field, July 1983.

8...Rocky Mountain Energy exploration-drilling site west of Wishbone Hill, Matanuska field, June 1983.

9...DGGS exploration drilling site in the Cape Beaufort region, Northern Alaska field. Photograph by A. Benet, July 1982.

10...Contractor drill-rig setup on DGGS coal exploration site at Chicago Creek, Seward Peninsula. Photograph by J.G. Clough, July 1983.

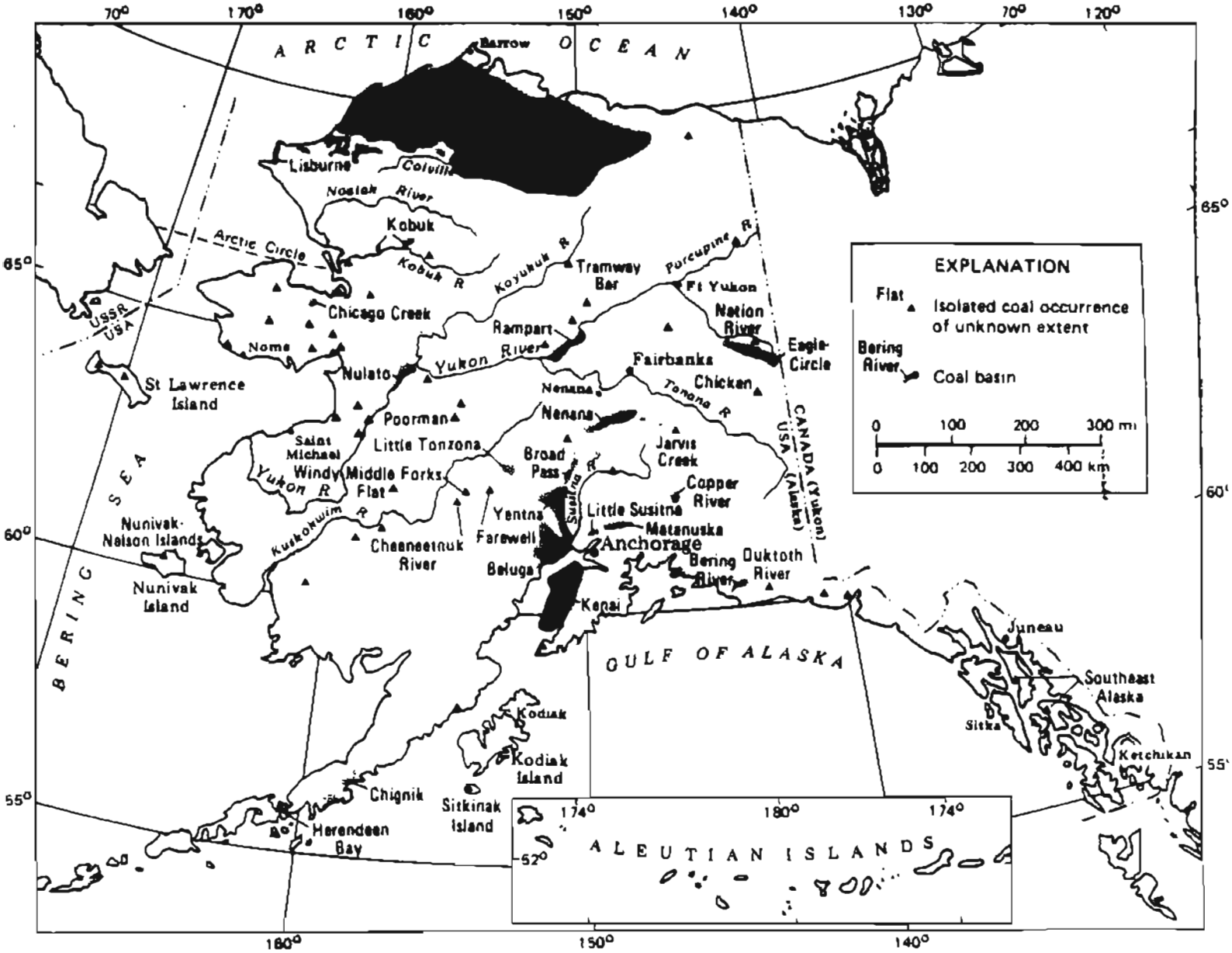
ARCTIC OCEAN
Barrow
Lisburne
Colville
Noatak River
Kobuk
Kobuk R
Koyukuk R
Arctic Circle
Tramway Bar
Porcupine R
Ft Yukon
Nation River
Eagle-Circle
Chicago Creek
Rampart
Yukon River
Fairbanks
Chicken
Tanana R
Nome
Nulato
Nenana
Nenana
Poorman
Little Tonzona
Saint Michael
Windy
Middle Forks
Yukon R
Flat
Broad Pass
Jarvis Creek
Copper River
Susitna R
Little Susitna
Matanuska
Anchorage
Yentna
Farewell
Kuskokwim R
Cheeneetnuk River
Beluga
Bering River
Duktoth River
Kenai
Nunivak-Nelson Islands
Nunivak Island
St Lawrence Island
USSR
USA
BERING SEA
CANADA (Yukon)
USA (Alaska)
GULF OF ALASKA
Juneau
Southeast Alaska
Sitka
Ketchikan
Kodiak
Kodiak Island
Sitkinak Island
Chignik
Herendeen Bay
ALEUTIAN ISLANDS
EXPLANATION
Flat
Isolated coal occurrence of unknown extent
Bering River
Coal basin
0 100 200 300 mi
0 100 200 300 400 km

Figure 1

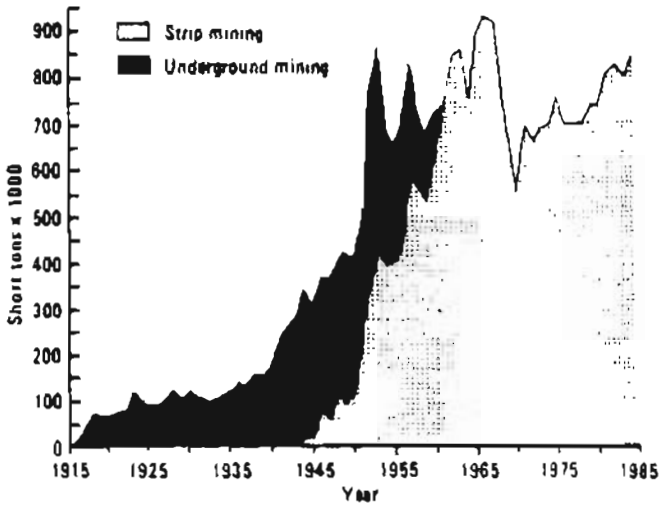
Strip mining
Underground mining
Short tons x 1000
900
800
700
600
500
400
300
200
100
0
1915
1925
1935
1945
1955
1965
1975
1985
Year

Figure 2

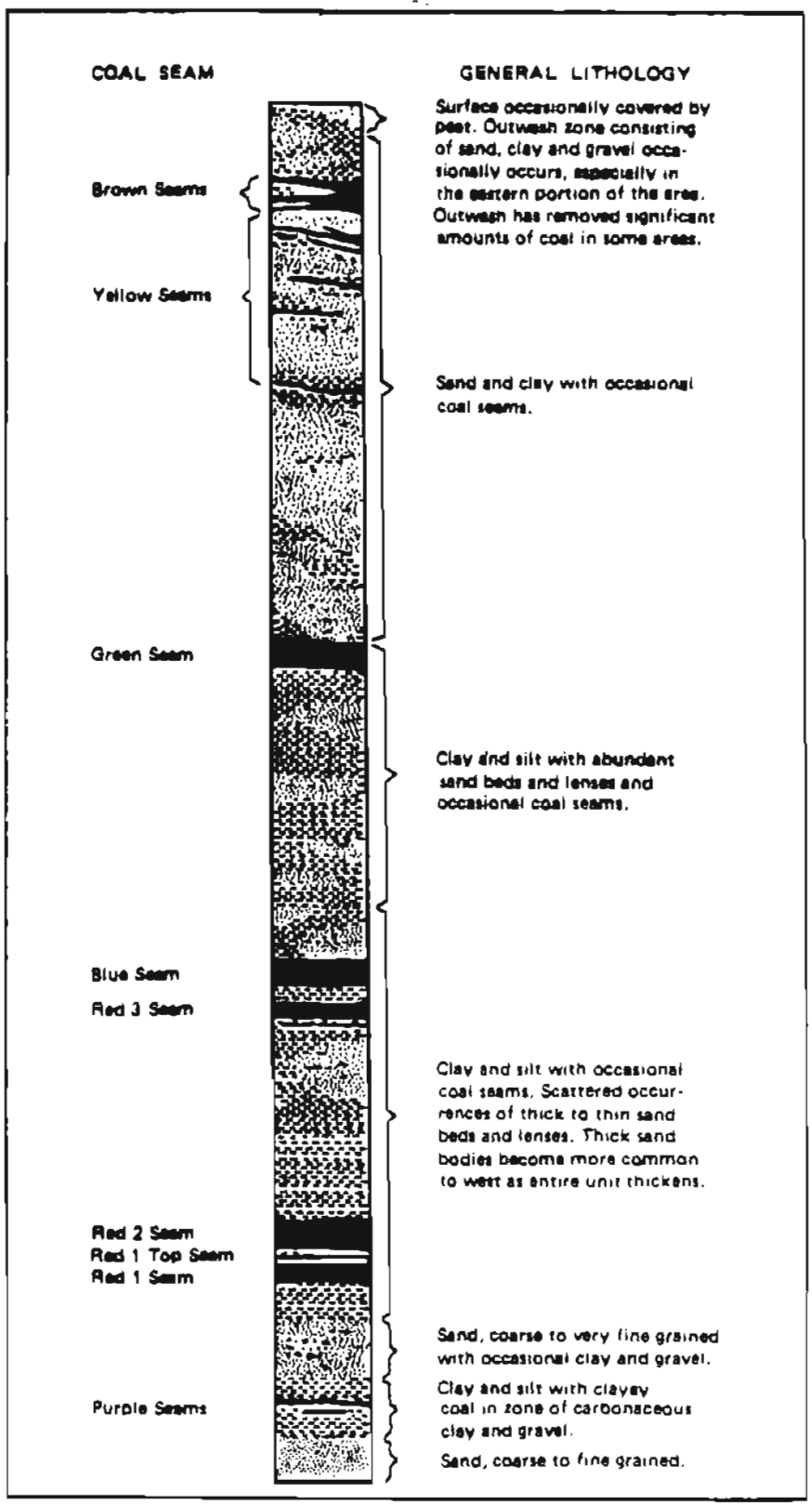
COAL SEAM
GENERAL LITHOLOGY
Surface occasionally covered by peat. Outwash zone consisting of sand, clay and gravel occasionally occurs, especially in the eastern portion of the area. Outwash has removed significant amounts of coal in some areas.
Brown Seams
Yellow Seams
Sand and clay with occasional coal seams.
Green Seam
Clay and silt with abundant sand beds and lenses and occasional coal seams.
Blue Seam
Red 3 Seam
Clay and silt with occasional coal seams. Scattered occurrences of thick to thin sand beds and lenses. Thick sand bodies become more common to west as entire unit thickens.
Red 2 Seam
Red 1 Top Seam
Red 1 Seam
Sand, coarse to very fine grained with occasional clay and gravel.
Clay and silt with clayey coal in zone of carbonaceous clay and gravel.
Purple Seams
Sand, coarse to fine grained.

Figure 3

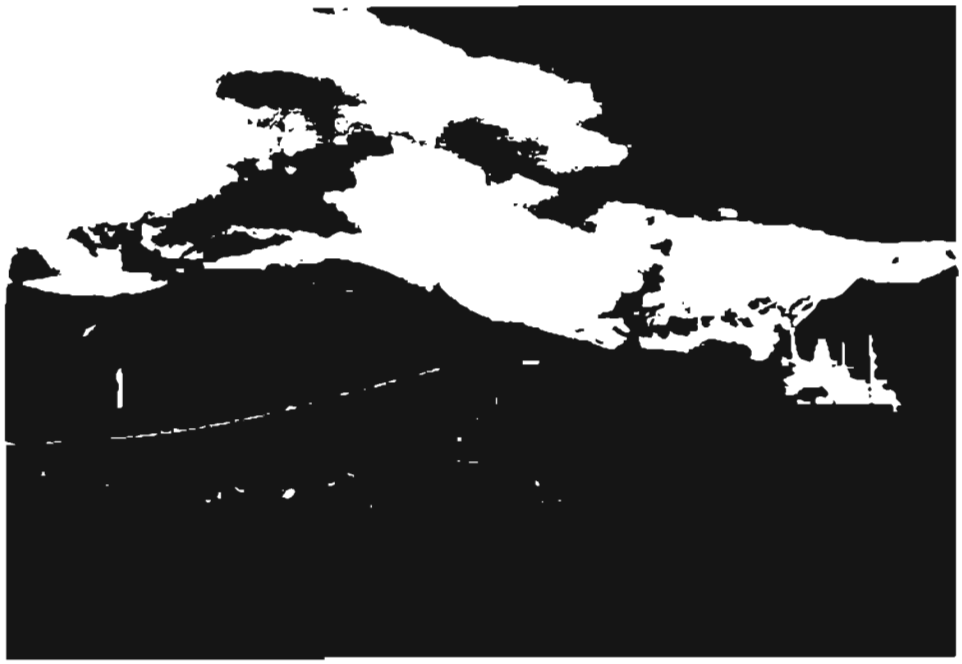

Figure 4

Figure 5

Figure 6

Figure 7

Figure 8

Figure 9

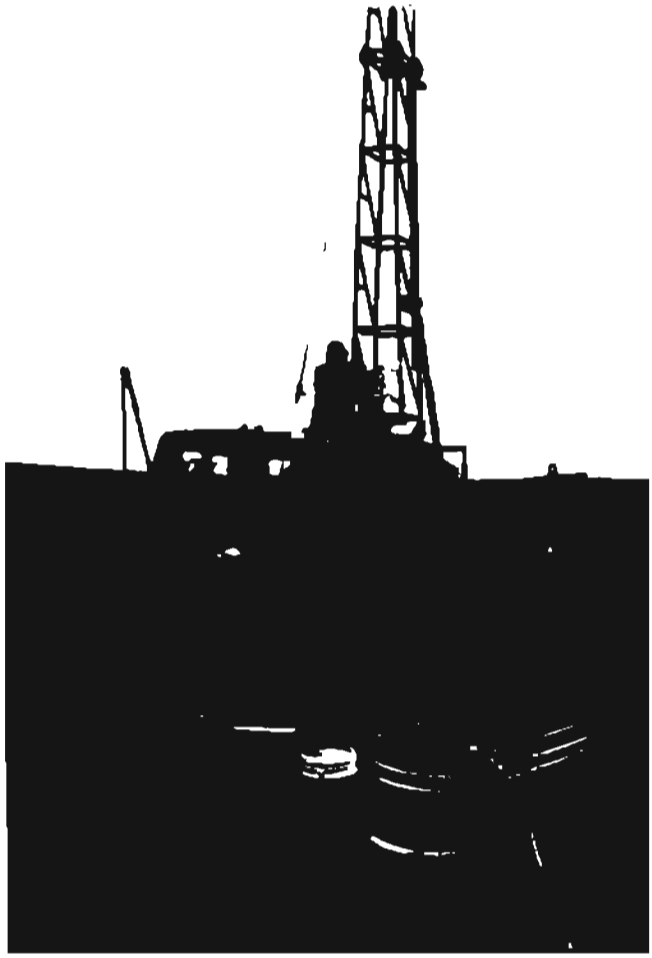

Figure 10