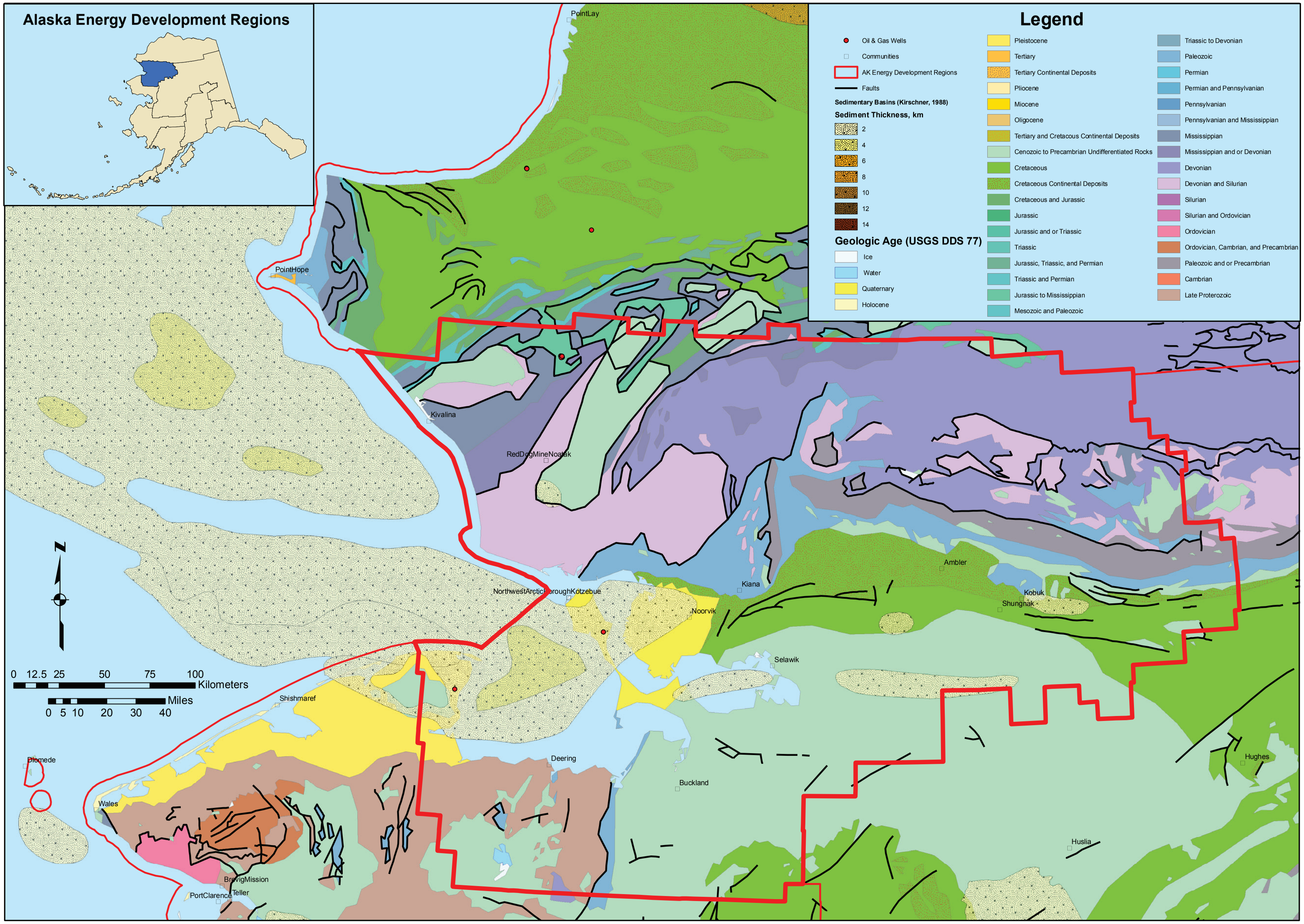
Geology of the Northwest Arctic Energy Region, Alaska



SUMMARY OF FOSSIL FUEL AND GEOTHERMAL RESOURCE POTENTIAL IN THE NORTHWEST ARCTIC ENERGY REGION

by Marwan A. Wartes

INTRODUCTION

Purpose of this report

Economic growth and stability in Alaska's rural areas hinges partially, if not primarily, on the availability of affordable and sustainable energy supplies. Recent price increases in oil and gas commodities have created severe economic hardship in many areas of the state that are dependent on diesel and heating oil as their primary source of energy. All sectors of Alaska's economy rely on affordable energy sources with limited price volatility, highlighting the need to diversify the energy portfolio by developing locally available and sustainable resources that are not tied to the global market. Unfortunately, all areas are not created equal in energy accessibility; the resources available for local exploitation vary widely across the state. It is critical that funding decisions for expensive programs to reduce the dependence on diesel for heat and electricity take into account information concerning the entire suite of natural resources that exist in a given area.

This report draws from existing information to provide community and state leaders an objective summary of our current knowledge concerning the potential of locally exploitable fossil fuel and geothermal energy resources in the Northwest Arctic Energy Region (fig. I1), one of 11 regions recognized by the Alaska Energy Authority (AEA) in their Energy Plan (AEA, 2009). The potential geologically hosted energy resources considered here include exploitable coal, conventional and unconventional oil and gas, and geothermal resources. This report concludes with recommendations as to what additional data or strategies, if any, would provide the most leverage in helping to develop new energy resources in the region.

Readers without geological training are encouraged to peruse the geologic summaries of fossil fuel resources and geothermal energy in Chapter A. They provide an overview of the geologic elements that must be present in an area to economically develop coal, conventional oil and gas, unconventional oil and gas, and geothermal resources. These summaries will provide the necessary background to more fully understand the information presented in this chapter.

Geographic and geologic setting

The Northwest Arctic Energy Region is approximately 39,000 square miles and includes the second largest borough in Alaska (sheet 1). There are 11 permanent villages in the region, and like much of remote western Alaska, transportation infrastructure is limited. The largest community in the region is Kotzebue, a regional hub with more than 3,000 residents. Other sizable communities include Selawik (population ~800) and Noorvik (population ~600). The remaining eight villages in the region each have fewer than 500 residents. The Red Dog mine, operated by Teck Cominco Alaska, is located in the northern part of the region and is an important regional employer.

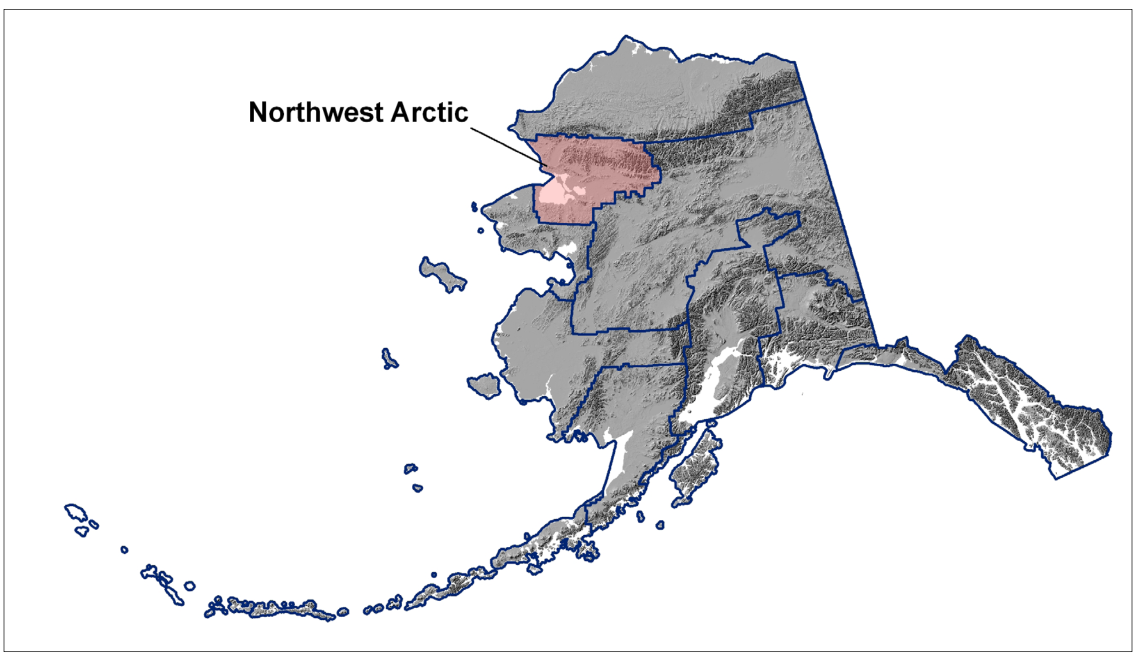


Figure I1. Location map of Northwest Arctic Energy Region.

The northern part of the Northwest Arctic Energy Region is bounded by the western Brooks Range. This compressional mountain belt includes the DeLong Mountains, which are a complexly folded and faulted series of Paleozoic and Mesozoic sedimentary rocks. The Baird Mountains upland lies further south and is composed of rock types similar to those of the northern Brooks Range, although they've been subjected to more intense pressure and temperature, resulting in metamorphism. These two upland areas are separated by the glacially sculpted Noatak lowland. The central part of the region lies south of the Brooks Range and is dominated by the Kobuk Selawik Lowlands, an expanse of low relief that is broken by modest topography in the Waring Mountains and Selawik Hills. The Kobuk River occupies the northern part of this lowland and drains westward into Kotzebue Sound. The landscape throughout this part of the region partly reflects the underlying geology, specifically the development of Cenozoic-age extensional sedimentary basins bounded by local uplifts (sheet 2). This series of basins may be a continuation of the distant offshore Hope Basin that generally thins eastward toward the Kotzebue Basin and eventually the smaller onshore Selawik trough, Kobuk Basin, and perhaps even the Noatak Valley. The southwest part of the region encompasses a portion of the Seward Peninsula that includes a southern onshore segment of the Kotzebue Basin. The Seward Peninsula also includes a number of Cretaceous- and Cenozoic-age plutonic and volcanic rocks, but is otherwise composed of metamorphic rocks similar to those of the southern Brooks Range. Beneath the eastern part of the Cenozoic-age sedimentary basins lies an older series of Jurassic and Cretaceous sedimentary, volcanic, and plutonic rocks. This complex belt of deformed rocks, termed the Koyukuk terrane, records the collision of an ancient volcanic chain that led to the formation of the ancestral Brooks Range.

GEOLOGIC ENERGY RESOURCE POTENTIAL IN THE NORTHWEST ARCTIC ENERGY REGION

Mineable coal resource potential

As explained in the discussion of requirements for mineable coal (see Chapter A), several factors must be considered when evaluating whether a coal deposit is exploitable. The most important factors include the maturity of the coal (rank), seam thickness, amount of impurities (ash and sulfur content), amount of overburden, and the degree of structural complications (steeply dipping seam, folds, faults, etc.). The higher the coal rank, the higher its energy content by weight. Coal rank also influences the minimum seam thickness worth exploiting. Low ash and sulfur contents are highly desirable, as ash represents the amount of non-combustible material in a seam and sulfur combines on combustion to form environmentally damaging compounds.

The Northwest Arctic Energy Region has a long history of using coal as an energy source, ranging from very local use by Inupiaq Eskimos to more substantial extraction efforts in support of gold mining, steamship, and related activities in the region. Significant development of this resource diminished in the early part of the twentieth century and commercial extraction efforts appear to have largely ceased by the 1930s. The following discussion summarizes information on coal occurrences in the Northwest Arctic Energy Region and briefly evaluates whether or not these resources might be reasonably exploited as a local energy source. The region's coal resources can generally be considered in two parts, based on their stratigraphic age (Cretaceous or Cenozoic).

Cretaceous Coal Occurrences. Cretaceous-age sedimentary rocks of the Koyukuk–Kobuk basin are present in the east-central part of the region, although they have not been studied in detail and are not well understood. Regionally, this package of rocks may be up to 8,000 meters thick, although reconnaissance geologic mapping in the Waring Mountains indicates that only a small part of these sediments were deposited in nonmarine environments conducive to coal development (Patton and Miller, 1968). No subsurface drilling data are available for these rocks and surface outcrops are generally described as poor and limited to local stream cuts. Nevertheless, a number of thin coal seams have been reported, particularly in the Waring Mountains and along the Kobuk River and its tributaries (fig. I2). Several of the more notable occurrences are described in the following paragraphs.

The Kallarichuk River area (fig. I2) has several isolated exposures of moderate to steeply dipping Late-Cretaceous-age coal-bearing rocks (Dames and Moore, 1980; Clough and others, 1982b; Goff and others, 1986). Several of these sites were actively mined as far back as the 1880s and the Haralan Mine probably yielded more than 150 tons of coal up through the early 1930s (Reed, 1931; Plangraphics, 1983). The Kobuk River "mine" was mined during the early days of the Squirrel River gold rush, and about 100 tons of coal may have been mined (Reed, 1931; Plangraphics, 1983). Subsequent attempts to revisit these mines and other exposures have met with limited success due to mine cave-ins, high river levels and generally poor exposure quality. However, the consensus is that a few of the coal beds are 1–2 feet thick, and most are considerably thinner. Coal quality analyses available are limited and indicate the coals are high-volatile bituminous, although the ash content is relatively high (Clough and others 1995).

Farther east on the Kobuk drainage a number of occurrences of coal have been reported over the years from the Hunt, Ambler, and Kogoluktuk rivers (fig. I3; see summaries in Dames and Moore, 1980; Goff and others, 1986). Based on their geologic position, they are most likely bituminous and related to coal-bearing strata found elsewhere along the Kobuk River. To date, all of these appear to be float, indicating that although coal is present in the vicinity, its thickness and quality remain unknown.

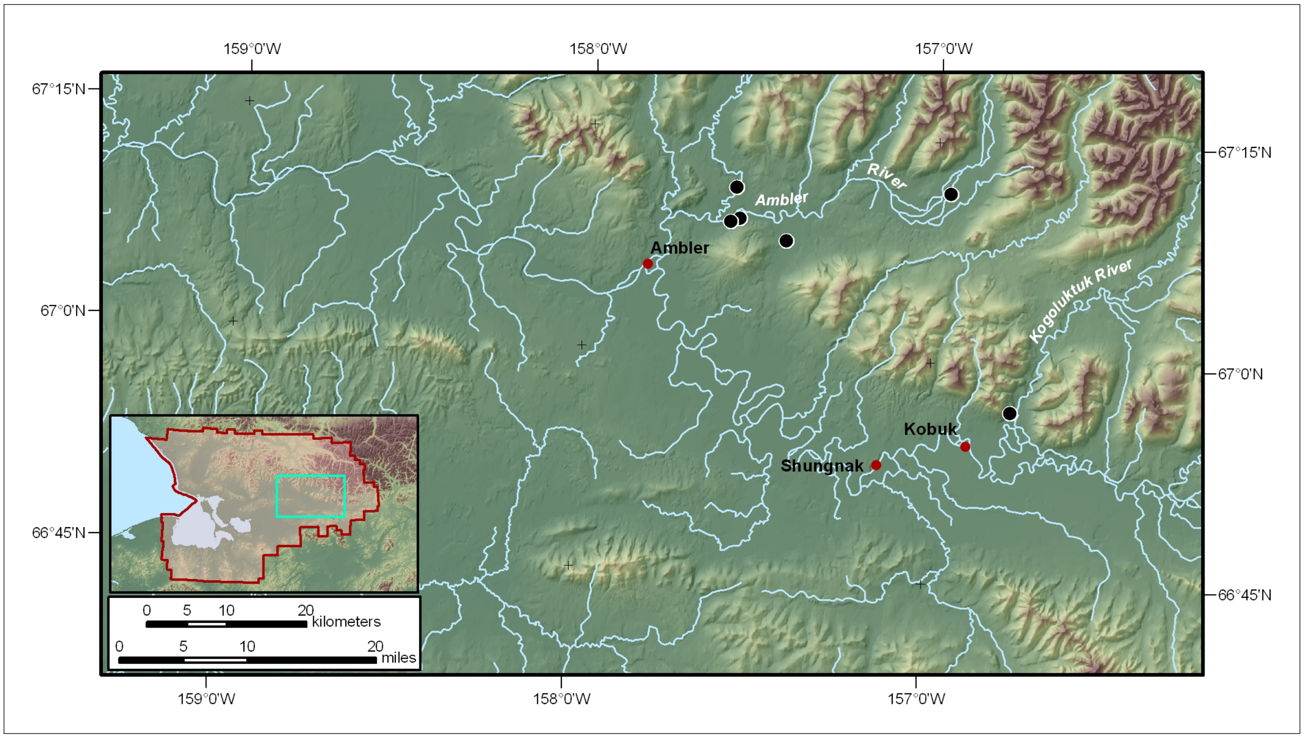


Figure I2. Location map of the west-central Northwest Arctic Energy Region, showing selected geographic references noted in the text. Black dots indicate reported coal occurrences; pick-axe symbols indicate historic coal mines in the Kobuk River area.

Several coal occurrences have been reported from the Hockley Hills, in the southwestern Waring Mountains. Exposures on the north side of the hills are poor and include only very thin streaks, but considerably thicker, more promising outcrops occur on the south side along the Singauruk River (fig. I2). The main exposure is about 300 feet up the river bluff and includes four main coal seams ranging from 3 to 6 feet thick (Clough and others, 1982a). Many thin shale partings occur with these seams and depending on the analytical technique employed, these coals range from subbituminous to bituminous; the latter assessment is likely more accurate considering the relatively high ash content (Clough and others 1995). This coal has properties similar to samples analyzed from the Kobuk River area and may be broadly correlative.

Cenozoic Coal Occurrences. Cenozoic sediments are interpreted to fill several separate but related sedimentary basins in the Northwest Arctic Energy Region based on scattered outcrops, two exploration wells, and widely spaced two-dimensional (2-D) seismic lines (sheet 2; Kirschner, 1994). These extensional basins are known to contain lignitic coals that are locally very thick, especially at the Chicago Creek mine (fig. I4), where extensive shallow drilling and geophysical work in the early 1980s constrained the local distribution and extent of the resource. The following discussion briefly summarizes known examples of Cenozoic coal at the surface.

The most important known occurrence of Cenozoic coals are from the Kugruk River and Kiwalik River areas (fig. I4) in the southwestern part of the region. Although surface exposures are lacking, several smaller tributaries (Chicago, French, Goose, Independence, Mina, Hunter, and Wilson creeks) (see summary in Dames and Moore, 1980) contain coal float, suggesting a potential coal resource likely underlies much of the area. Four small mines (Chicago Creek, Wallin, Superior, and Kugruk) were active in the early 19th century, all probably exploiting the same very thick coal seam (Plangraphics, Inc., 1983; Clough and others, 1995). In the early to mid 1980s, the State of Alaska sponsored a significant investigation of the most promising of these mines at Chicago Creek, acquiring subsurface information on the resource. Of particular note were 14 shallow drill holes totaling 2,800 feet that offer vital constraints on the lateral continuity and thickness variability of the resource. Summaries of this work indicate that the main coal seam has been traced over 8,000 feet laterally in the subsurface and reaches thicknesses of up to 100 feet (Ramsey and others, 1986). Correlations between drill holes indicate significant complications due to folding and faulting and the coal is highly deformed locally. Coal quality data indicate a low rank of lignite with significant moisture content typical of low-maturity coals (Clough and others, 1995). Based on this subsurface delineation, the Chicago Creek mine area is estimated to contain at least 3.4 million tons of demonstrated coal resource (Ramsey

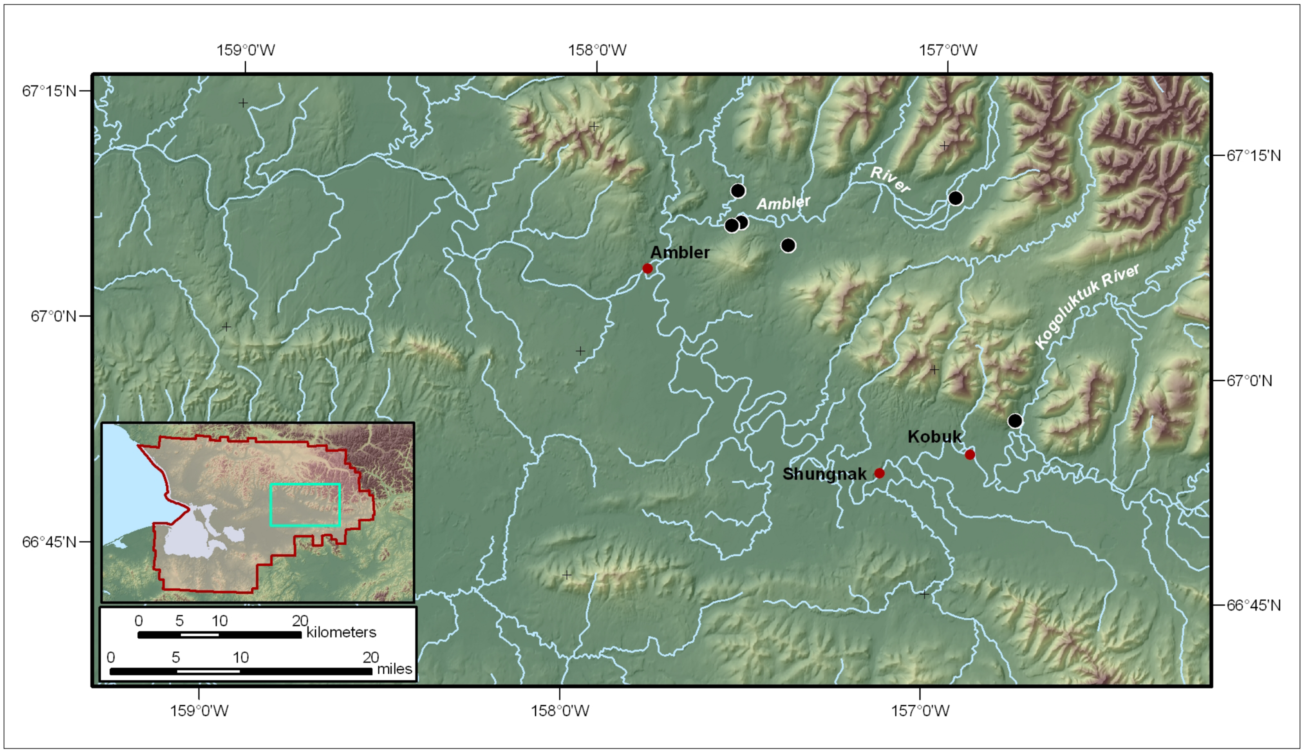


Figure I3. Location map of the east-central Northwest Arctic Energy Region, showing selected geographic references noted in the text. Black dots indicate reported coal occurrences.

and others, 1986). A significant result from this work was a preliminary mine plan and feasibility study in the mid-1980s that suggested this resource could provide a 30-year power supply for Kotzebue if an average of 50,000 short tons of lignite were mined per year (Retherford and others, 1986).

Another often-cited coal occurrence is near Elephant Point in Eschscholtz Bay (fig. I4; Patton and Miller, 1968; Patton, 1973). When first noted in 1909, the coal was reported to be 2 feet thick, although subsequent investigations have only noted a 4-inch-thick bed exposed at low tide (Dames and Moore, 1980). Although no analyses have been performed on this coal, it is most likely lignite. Farther east, additional coal float has also been reported from a small tributary of the Mangoak River (fig. I4; Patton and Miller, 1968; Patton, 1973). This is also most likely Cenozoic lignite that accumulated near the southern margin of the Selawik trough (sheet 2), or a subsidiary smaller, fault-bounded basin.

Conventional oil and gas resource potential

As explained in the discussion of requirements for exploitable oil and gas resources (see Chapter A), functioning petroleum systems occur in thick sedimentary basins, and consist of three basic elements: Effective source rocks, reservoirs, and traps. Each of the elements must be in existence and connected at the time hydrocarbons are generated. This section considers each of these necessary elements of petroleum systems in turn to evaluate whether conventional oil and gas resources may exist as an exploitable resource in the Northwest Arctic Energy Region.

Overview of sedimentary basins. Sheet 2 shows the distribution of sedimentary basins (after Kirschner, 1988) that could potentially host petroleum systems in the Northwest Arctic Energy Region. The main sedimentary basins are a family of relatively thin, Cenozoic-age, fault-bounded lows created by crustal extension. The largest of these, the Kotzebue basin, is dominantly offshore and separated from the larger Hope basin in the Chukchi Sea by the Kotzebue arch. East of Kotzebue Sound, the Selawik basin (also called trough) occupies the lowlands between the Waring Mountains and the Selawik Hills. Based principally on gravity data, several smaller basins have been identified, including the Noatak basin and subsidiary basins north and northeast of the main Selawik basin (Troutman and Stanley, 2003). Older Cretaceous sedimentary strata are very thick along the southern Brooks Range, indicating a significant sedimentary basin once existed here, although intense folding and faulting has uplifted and dissected these rocks.

Source rocks. Oil-prone source rocks are not recognized beneath or associated with the Cenozoic basins. The basement rocks for much of the area are metamorphic and thus not potential sources of oil or gas. This unfavorable basement rock type can be inferred from regional geology in the southern Brooks Range and Seward Peninsula, but was further confirmed at the bottom of the two exploration

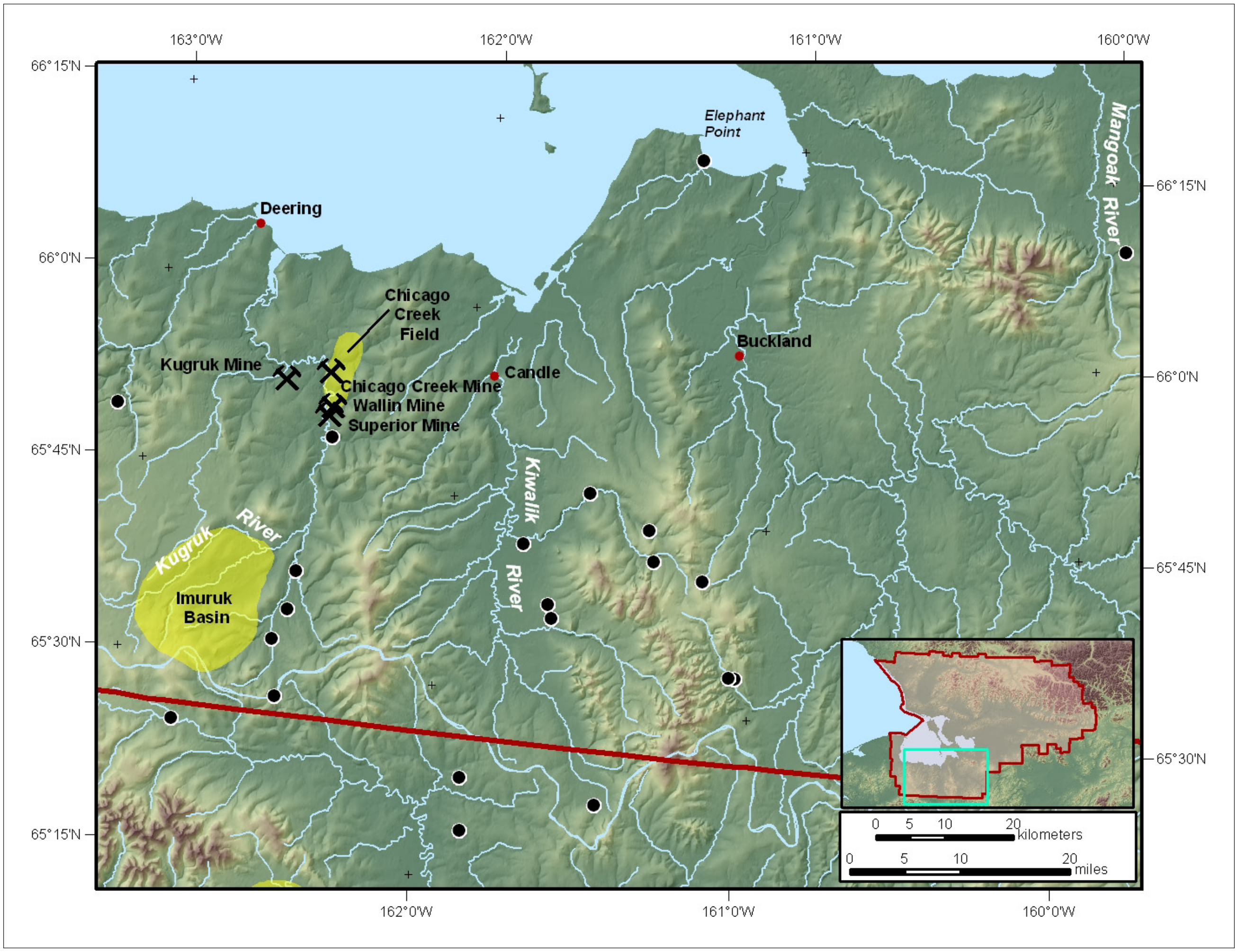


Figure I4. Location map of the southern Northwest Arctic Energy Region, showing selected geographic references noted in the text. Black dots indicate reported coal occurrences; pick-axe symbols indicate historic coal mines in the Kugruk River area.

wells in the Kotzebue basin (sheet 2; Nimiuk Point and Cape Espenberg; Fisher, 1988). In addition, shallow drill holes at Chicago Creek documented metamorphic rocks directly underlying the Cenozoic lignite section (Ramsey and others, 1986). The Selawik basin, which is farther inland, may partly be underlain by the thick Cretaceous sediments recognized in the Waring Mountains. However, selected outcrop samples indicate these rocks are overmature and have very low amounts of organic carbon and do not represent viable source rocks for oil or gas (Decker and others, 1987).

Source rock data from the two exploration wells also were not encouraging. The samples from the wells indicate that low amounts of organic carbon are present and the composition of the organic matter is dominantly cellulosic, meaning it would be gas-prone, if sufficiently matured (Decker and others, 1987). Thermal maturity values indicate the section has not been sufficiently buried or heated to generate thermogenic gas. These observations are consistent with data from the scattered outcrops of coal-bearing Cenozoic strata in the region, indicating the coals are all still lignite and thus have not been deeply buried.

Biogenic gas, generated by microbial processes, is often considered an unconventional resource due to its method of production in coalbed methane systems (see Chapter A). However, in some basins, such as the prolific Cook Inlet in southern Alaska, biogenic methane has been known to occur in conventional reservoirs. Due to the unusually thick Cenozoic coals recognized at Chicago Creek, it is reasonable to assume biogenic gas has been generated due to the microbial breakdown of buried organic matter. The presence of biogenic gas is supported by trace amounts of methane associated with coal-bearing strata in both exploration wells in the region (Troutman and Stanley, 2003). However, in order for biogenic gas to migrate into a conventional reservoir, an unusual set of geologic conditions are required involving the formation of early traps, rapid burial, and finally rapid uplift (Rice, 1993).

Small amounts of gas have been encountered in shallow drilling around Kotzebue Sound (seismic shot holes and a water well). These occurrences are all considered to be biogenic (Troutman and Stanley, 2003) based on their chemistry. The shallow positions of the encountered gas may suggest that it is produced by small amounts of decaying organic matter (Miller and others, 1959) with the resulting methane byproduct likely trapped beneath impermeable permafrost. This type of ephemeral accumulation is not likely to yield sustained production.

Reservoir rocks. Sparse data indicate the reservoir quality in the region is variable, but generally low. The abundance of chemically unstable volcanic debris in sandstone commonly produces poor reservoirs. Based on 39 samples of Cretaceous sandstone, the average porosity was 4.7 percent, significantly lower than required for conventional petroleum reservoirs (Decker and others, 1987). The low reservoir quality suggested by these results is consistent with regional studies of these rocks across western Alaska, which indicates minerals such as laumontite have precipitated in the pore space (Hoare and others, 1964).

The younger Cenozoic section is likely to have better reservoir quality due to less burial. Porosity values extrapolated from geophysical logs in the two exploration wells suggest values as high as 40 percent in the shallow section, decreasing to 5 percent near the base (Fisher, 1982). The elevated porosity is probably a function of limited compaction and cementation in the near-surface sediments. The consistent decrease in reservoir quality with depth is not encouraging, and deeper targets in the Kotzebue and Selawik basins would presumably follow a similar trend.

Traps. Existing geologic maps indicate variable intensities of folding and faulting have impacted the region. The Cretaceous rocks in the Waring Mountains and Kobuk River area are complexly deformed, likely by multiple phases of tectonics. This history suggests the development and preservation of structural traps is very unlikely and that exploration for such targets would be challenged to find accumulations.

The extension that created Cenozoic basins in the region is conducive to the development of a variety of hydrocarbon traps. The juxtaposition of uplifted blocks and down-dropped lows, combined with local and regional tilting, can be effective elements of a trap. Although seismic data are limited, the available lines indicate that reasonable trapping geometries may be present in the Kotzebue and Selawik basins. Due to the very limited exploratory drilling, many untested large structures are likely to be present. If shallow biogenic accumulations are targeted, the integrity of seal rocks may present a risk factor due to insufficient compaction.

Summary of conventional oil and gas resource potential. The regional potential for oil accumulations is considered low due to the lack of identified oil-prone source rocks. In the northern and eastern parts of the region, the potential is further hampered by poor reservoir quality and structural complexity. In the Cenozoic basins, data suggest most rocks are immature, having been subjected to insufficient burial to convert the organic matter to liquid hydrocarbons. Conventional gas prospects are considered fair due to the abundance of terrestrial organic matter. It is possible that sufficient maturity has been reached in the deepest parts of the Kotzebue–Selawik basins for the generation of thermogenic gas. In addition, it remains possible that biogenic gas could have accumulated in conventional reservoirs, similar to the process inferred for Cook Inlet. However, this unusual phenomenon requires an abrupt decrease in the hydrostatic pressure (usually by uplift) in order for the gas to migrate. At present, the timing and magnitude of any uplift events involving Cenozoic strata in the Kotzebue and Selawik basins are insufficiently known to reliably evaluate this potential. Although the likelihood of this mechanism operating in this region is low, additional field studies (geologic mapping, structural studies, thermochronology, etc) would help to test the viability of this resource type for exploration.

Unconventional oil and gas resource potential

Coalbed methane. The region possesses abundant evidence for coal (see above), which is the required ingredient for this resource. However, most thick Cenozoic coals are lignite and thus do not have well-developed cleating. These natural fractures create the permeability that is required to effectively produce methane hosted in the coal (see Chapter A). The onshore Selawik basin may have as much as 10,000 feet of basin fill (Patton, 1973), allowing for the possibility that deeper parts of the basin may have witnessed sufficient burial maturity to develop cleating. The older Cretaceous coal-bearing section around the Kobuk River area likely has better maturity (bituminous) and includes adequate cleating. However, the surface exposures of these coals indicate they are considerably thinner and more structurally complex than the Cenozoic examples. Available surface mapping indicates coal beds are often steeply dipping and affected by extensive folding and faulting—all of which adds a significant component of risk to exploration success. Presently the geometry and distribution of these coals in the subsurface are very poorly known.

Tight gas sands. The Cretaceous sediments in the Kobuk River region could be categorized as tight gas sands based on their low permeability. However, the absence of source rocks and structural complexity suggests the potential for gas accumulation is very low. The Cenozoic sediments associated with the Kotzebue, Selawik, and other basins have similarly provided little evidence for source rocks, and available data indicate insufficient maturity has been reached to generate thermogenic gas (Decker and others, 1987). There is evidence for mature source rocks in the western Brooks Range and it is conceivable some gas is trapped in low-porosity sandstone or limestone. However, the repeated episodes of folding and faulting that have affected this area diminish the probability of a trap maintaining its integrity.

Shale gas. Similar to tight gas, noted above, most of the region lacks the identified source rocks necessary for a successful shale gas petroleum system. The exception is within the western Brooks Range (northwestern part of the region), where organic-rich, Mississippian-age mudstones are recognized to contain gas trapped in a self-sourcing system. The large Red Dog Mine received State approval for a multi-well exploration program to explore for this resource, hoping to replace or defray the escalating cost of diesel fuel (Alaska Division of Oil & Gas, 2006). The targeted shales have good to excellent total organic carbon contents (up to 15 percent) and measured gas contents ranging from ~16 to 65 scf/ton, comparable to many successful shale-gas fields in the Lower 48. As noted in the description of this resource type (see Chapter A), successful production of this gas will require the rock to be manually fractured to induce permeability and flow. In addition, substantial volumes of water would be produced and appropriate disposal of this water must be considered in evaluating exploration costs. Although the preliminary results from the shale gas exploration around Red Dog have been promising, it is unclear how extensive this resource might be. Similar rocks are known across the western Brooks Range, although the only villages situated nearby are Noatak and possibly Kivalina.

Gas hydrates. Gas hydrates are found in a narrow range of modern environments and only occur within specific temperature and pressure conditions. Presently, Alaska's North Slope appears to be the only onshore region with sufficient permafrost to preserve methane hydrate.

Geothermal resource potential

There are limited data regarding the geothermal prospectivity of the region, but regional geologic considerations indicate several conditions are present that commonly lead to elevated near-surface temperatures. These include evidence for recent crustal extension, geologically young volcanic activity, and possibly elevated geothermal gradient of about 104°F (40°C) (Fisher, 1988). However, these characteristics by themselves do not result in an exploitable resource. Only three recognized thermal springs lie within the region (sheet 2): The Reed River, Upper Division, and Lower Division springs (Motyka and others, 1983). The Reed River occurrence (Pessel, 1975) is in the easternmost part of the region, but its protected land status (Gates of the Arctic National Park) precludes future development. The Division hot springs are located in the southeastern part of the region in the Purcell Mountains, approximately 40 miles south of the villages of Kobuk and Shungnak. This family of springs issues at very high rates (up to 547 gallons per minute) from an unusually radioactive pluton (Miller and Johnson, 1978). Although this flow rate is promising, measured temperatures of less than 158°F (70°C) are below the threshold required for modern small power generation units (Kolker, 2009).

The Seward Peninsula area of the adjacent Bering Energy Region has several prospective geothermal resources that may benefit the Northwest Arctic Energy Region. Of particular note is the Granite Mountain hot spring approximately 40 miles south of Buckland. The characteristics of this occurrence are similar to the Division hot springs in terms of possessing excellent flow rates, but sub-optimal temperatures.

RECOMMENDATIONS

Coal resource recommendations

The Northwest Arctic Energy Region contains widely spaced Cretaceous and Cenozoic coal occurrences that should be considered as a potentially viable source of energy for local use. Not all occurrences are located near villages (figs. I2–I4), and it is recommended that any future work focus on those coals that might most economically serve regional needs. Many of the coals in the area have not been adequately evaluated; the following discussion offers some general comments on the potential for locally developing coal as an energy source and highlights additional work that might mitigate risk and improve the knowledge of this resource.

Significantly more geologic information is needed to reliably assess the Cretaceous coal prospects. Although the bituminous rank is promising, the lateral continuity of coal beds and correlations between outcrops remain unknown. Additional surface fieldwork, such as detailed geologic mapping and stratigraphic studies, might offer some first-order constraints on the geologic context of these coals, although ultimately drilling would likely be required to delineate this resource. The generalized map pattern shown for the Cretaceous coal-bearing strata (Patton and Miller, 1968) is perhaps misleading with respect to the structural complexity of the area. As noted by the authors in text discussions, the Waring Mountains and Kobuk River area has been significantly deformed as evidenced by numerous tight folds and high-angle faults, many of which could not be depicted at the reconnaissance scale of that mapping. These complications are relevant as they add significant risk to development mining where the orientation of the target seam is difficult to predict or is abruptly offset by faulting. Despite these caveats, it is possible there are sufficient Cretaceous coal deposits for local energy use, particularly those villages that might be served by shipments along the Kobuk and Singauruk rivers. It is noteworthy that some of the coal occurrences in the Kobuk region are within designated National Park lands and likely unavailable for mine development.

The Tertiary coals in the Chicago Creek area are exceptionally thick and warrant additional consideration as a potential long-term source of energy. The existing subsurface data for this area has sufficiently documented the resource and a robust cost estimate and engineering plan for development of a modern mine could be calculated. Nevertheless, the existing geologic information indicates there would still be uncertainty associated with efforts to exploit this resource. Perhaps most importantly, a detailed understanding of the distribution of faults and folds in the area would greatly reduce the risk associated with predicting coal distribution. Additional drilling or geophysical techniques, such as detailed magnetometer surveys (Ramsey and others, 1986), might supply the necessary constraints on the structural geology. It is also important to note that the low grade of this coal will require more lignite to be mined than would be required for a bituminous coal that has a much higher energy density. Further, the high moisture content may increase processing costs. Depending on the scale of a proposed mine in this area and the preferred method of power transmission, this resource could potentially support several communities bordering Kotzebue Sound.

Unconventional oil and gas resource recommendations

Coalbed methane. The abundance of terrestrial organic matter in the form of coal gives rise to possible coalbed methane prospects in the region, particularly in the deeper parts of the Selawik trough. The better studied and thickest seams in the region are undermature, whereas those with adequate maturity are poorly known and likely to be structurally disrupted. Seismic data would be helpful in evaluating the lateral continuity of coal bearing-sections and the total thickness of basin fill in the Selawik trough. This type of data would also be useful for inferring burial history and maturity—key parameters in identifying viable targets for coalbed methane exploration.

Tight gas sands. The complex geological history of the Northwest Arctic Energy Region suggests that the tight gas sand resource potential is low.

Shale gas. Early reports from shale gas exploration near the Red Dog mine appear promising and may ultimately yield sufficient gas for local and even regional use. If a sufficient resource can be documented and the considerable development challenges overcome, this may entice a larger exploration effort to document the extent of shale gas. It should be noted that exploration in the immediate Red Dog area leverages decades of detailed geologic study and dense mineral prospect drilling. An expanded search for this type of resource would require a substantial geologic field program to better map the regional geology of the western Brooks Range.

Gas hydrates. Due to the lack of extensive, continuous permafrost in the Northwest Arctic, the likelihood of finding gas hydrates in the region is very low therefore no further action is recommended.

Conventional oil and gas resource recommendations

The regional potential for oil accumulations is considered low due to the lack of identified oil-prone source rocks. Conventional gas prospects are considered fair due to the abundance of terrestrial organic matter. Due to the limited outcrops, the acquisition of expensive subsurface data (seismic and wells) would be most useful in evaluating the region's potential. The region's Native corporation (NANA) recently reached an agreement with Trio Petroleum to drill as many as four exploration wells in the Kotzebue Sound area (Petroleum News, 2009); the results of this program will provide much-needed new constraints on the ultimate potential of this area to host conventional oil and gas resources.

Geothermal resource recommendations

The southernmost part of the region is likely to be the most prospective, based on regional, though isolated, surface indications of elevated geothermal activity across central and western Alaska. Unfortunately, identified resources are all at least 40 miles from the nearest settlement, meaning power transmission costs would likely be prohibitive. However, further geologic studies of known sites such as Granite Mountain and Division, may extend the subsurface footprint of the resource and shorten the ultimate distance between power generation and consumption. In particular, soil surveys and possibly remote geophysical techniques may assist in improved delineation of the geothermal anomalies (Kolker, 2009).

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