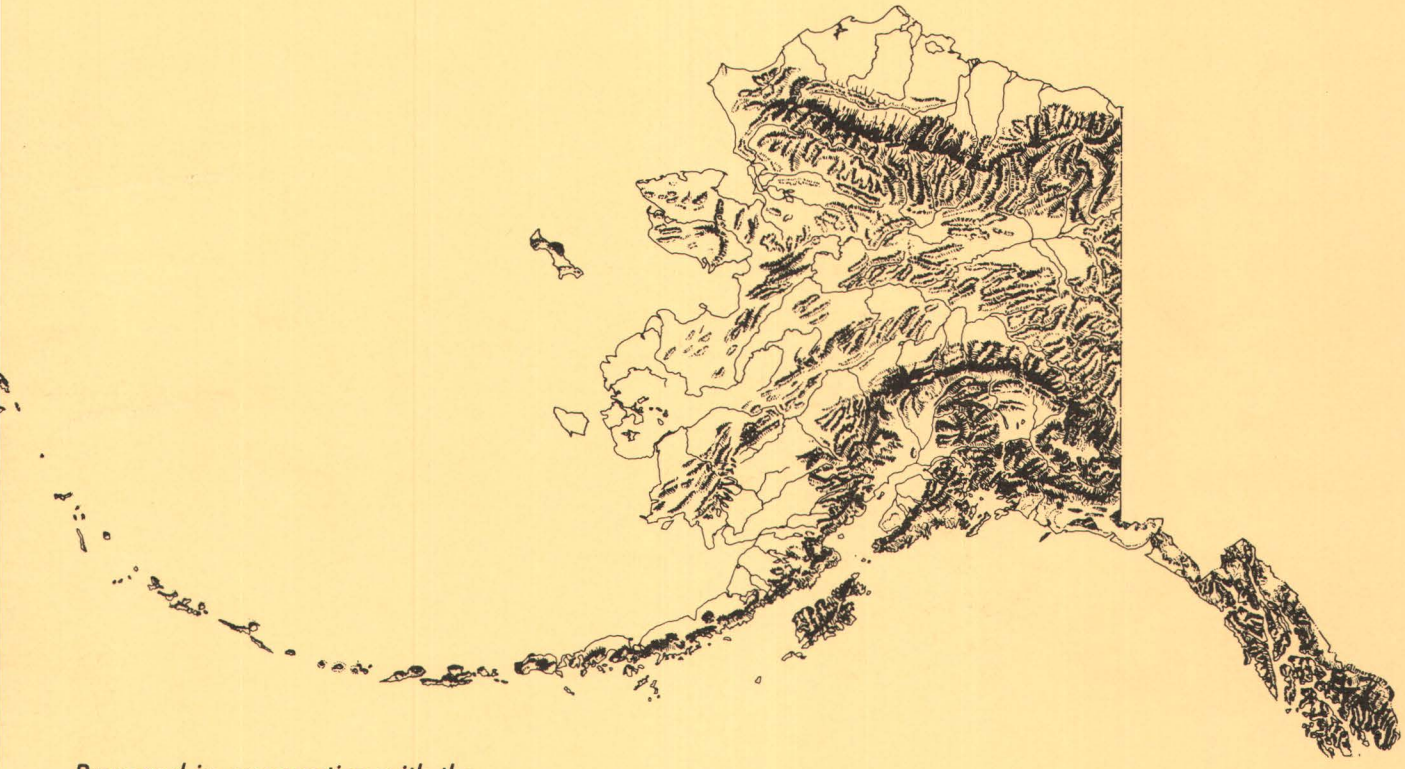
1986 Annual Report on Alaska's Mineral Resources

U.S. GEOLOGICAL SURVEY CIRCULAR 983



Prepared in cooperation with the Bureau of Mines, the Bureau of Land Management, the National Park Service, the U.S. Fish and Wildlife Service, the Department of Agriculture—Forest Service, and the Department of Energy

As mandated by Section 1011 of the Alaska National Interest Lands Conservation Act, Public Law 96–487, of December 2, 1980

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1986

DEPARTMENT OF THE INTERIOR
DONALD PAUL HODEL, Secretary

U.S. GEOLOGICAL SURVEY
Dallas L. Peck, Director

The Library of Congress has cataloged this serial publication as follows:

Annual report on Alaska's mineral resources. 1982-[Reston, Va]: U.S. Dept. of the Interior, Geological Survey. [1982-
v. : maps ; 26cm.—(Geological Survey circular)
Annual.
"As mandated by section 1011 of the Alaska National Interest Conservation Act, Public Law 96-487, of Dec. 2, 1980."
Supt. of Docs. no.: I 19.4/2:
GPO: Item 620-A
ISSN 8755-0709 = Annual report on Alaska's mineral resources.

1. Mines and mineral resources—Alaska—Periodicals. I. Geological Survey (U.S.) II. Series: U.S. Geological Survey circular. TN24.A4A66 553'.09798–dc19 85–642168 AACR 2
MARC-S Library of Congress [8604]

Free on application to the Books and Open-File Reports Section,
U.S. Geological Survey, Federal Center, Box 25425, Denver, CO 80225

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Prepared by the U.S. Geological Survey, in cooperation with the Bureau of Mines, the Bureau of Land Management, the National Park Service, the U.S. Fish and Wildlife Service, the Department of Agriculture—Forest Service, and the Department of Energy

SUMMARY

Section 1011 of the Alaska National Interest Lands Conservation Act (ANILCA) of 1980 requires that "On or before October 1, 1982, and annually thereafter, the President shall transmit to Congress all pertinent public information relating to minerals in Alaska gathered by the United States Geological Survey, Bureau of Mines, and any other Federal agency." This report was prepared in response to that requirement.

The U.S. Geological Survey and the Bureau of Mines are the principal Federal agencies that publish information about mineral resources in Alaska. Their reports and data are commonly used by other Federal agencies in making decisions about land use, access, environmental impacts, and claim evaluation. Because of the time required for sample analysis and data synthesis and the publication process, scientific reports are generally issued a year or more after data and sample collection. Other sources of information included Federal and State publications, trade and professional journals, newspaper and magazine articles, talks at public meetings and hearings, and press releases.

This is the fifth in the series of annual ANILCA reports. It provides information about current projects and events that occurred during 1985 and in the early months of 1986; emphasis is on Federal activity. This report addresses onshore areas of Alaska only. Information is provided for two broad categories of minerals: energy resources and nonfuel minerals.

OIL AND GAS

Alaskan oil production increased by nearly 100,000 barrels per day during 1985 and was responsible for a slight overall gain in the Nation's oil output over the previous year. Alaska continues to rank second among oil-producing States. In 1985, the North Slope and Cook Inlet, Alaska's two petroleum-producing areas, provided a total of more than 666 million barrels of oil, more than 206 billion cubic feet of dry natural gas, and 1.15 billion cubic feet of casinghead gas. These totals represent an increase of about 5.6 percent for oil and 3 percent for dry natural gas over the 1984 totals. Alaska continues to provide about 20 percent of the United States oil production. During May 1985, U.S. oil production reached its highest level since 1974, most of the gain being attributed to production increases from the Kuparuk River field on the North Slope.

Industry onshore exploration and development drilling in Alaska in 1985 proceeded at a faster pace than in 1984. State and Federal agencies continued their regulatory functions and conducted lease sales and surveys relating to land classification and oil and gas resource evaluation. Exploration activity included geological and geophysical surveys and drilling of eight exploratory wells, six on the North Slope, and one each in the Bristol Bay and Cook Inlet basins of southern Alaska. Development activity included the startup of production from the Milne Point field (the third producing field on the North Slope), drilling about 230 new production wells, mostly in the Prudhoe Bay and Kuparuk fields, and the continuation of enhanced oil recovery projects in both fields.

Three competitive oil and gas lease sales were held in 1985, all by the State of Alaska. Companies and groups of investors bid nearly $20 million for about one-half million acres of land at these events. A competitive lease sale for land in the National Petroleum Reserve in Alaska was postponed for at least 1 year.

Federal agencies conducted studies related to oil and gas as required by ANILCA. This year marked the culmination of a major interagency study of the oil, gas, and wildlife resources and wilderness characteristics of the Arctic National Wildlife Refuge. The Fish and Wildlife Service, Bureau of Land Management, and the U.S. Geological Survey have been preparing a report to Congress due in late 1986 describing their respective assessments of the refuge.

COAL AND PEAT

Industrial interest and activity continued in four coal fields in southern Alaska. Coal production plans center on Pacific markets and local electrical power generation; all development plans depend on coal prices and competition from hydroelectric or petroleum-fired powerplants. Coals from these fields have low sulfur contents, and the risk of combustion during shipping is low for such coals.

The Usibelli Coal Mine, in the Healy coal field of interior Alaska, produced more than 1.3 million short tons of coal, of which more than half was shipped to Korea. This was the second year of coal export for the company.

State of Alaska geologists are investigating a coal field in northwest Alaska as a source of local heat and power and a possible power source for the planned Red Dog zinc-lead-silver mine.

The U.S. Geological Survey continues to assess coal resources in the central part of the North Slope and along the northern flank of the Brooks Range. This coal is part of the very large Northern Alaska field. Survey studies are also ongoing in the Bering River coal field near Prince William Sound.

Peat use in the past year has been almost entirely in horticultural applications. The decline in new home construction caused a decline in peat production relative to previous years. Federal studies of peat are under way as part of a mineral assessment of a quadrangle in west-central Alaska.

URANIUM RESOURCES

The world surplus of uranium continues to create a low demand. Consequently, there is little uranium exploration activity nationwide, and particularly in Alaska, with its high exploration and production costs. The U.S. Geological Survey continued basic studies of uranium-bearing rocks in several parts of Alaska. The Department of Energy released a report that describes analyses for uranium and other elements in stream-sediment and water samples for Alaska.

GEOTHERMAL RESOURCES

Geothermal resource studies focused on the Mount Spurr area, the Copper River Basin, and volcanic centers in the Aleutian Islands. Of these, the Aleutian areas are thought to have the greatest potential for local power generation. The University of Alaska and the State of Alaska Division of Geological and Geophysical Surveys have cooperated in this work, with funding from the Department of Energy. Two tracts were leased in a State geothermal lease sale on June 24, 1986.

NONFUEL MINERALS

Low mineral prices and the generally depressed condition of the domestic mining industry were reflected in Alaska by a decline in the number of new mining claims and in expenditures for mineral exploration and development. Nevertheless, the value of Alaska's total mineral production for 1985 rose to $226.4 million, an increase of about $27 million above the value for 1984. Gold production increased by nearly 10 percent, to 190,000 ounces. However, placer miners are faced with several significant problems, principally compliance with water-quality standards and the regulation of mining activities on State and Federal lands.

The demand for sand and gravel, primarily for construction of pads for petroleum-related facilities, resulted in an increase in production to the extent that their value exceeded that of gold in 1985.

Several major mining projects moved yet closer to production in 1985 and early 1986. Construction of a shallow-water dock and the staging area at the port for the Red Dog zinc-lead-silver deposit in northwestern Alaska has begun. The Final Environmental Impact Statement for the Quartz

Hill molybdenum deposit near Ketchikan is to be submitted in 1986; construction projects for mine operation may follow in the next 4 years. Work at the Greens Creek zinc-lead-copper deposit on Admiralty Island in southeastern Alaska is nearing the end of the exploration stage.

The results of studies that are part of two U.S. Geological Survey programs, the Alaska Mineral Resource Assessment Program and the Trans-Alaska Crustal Transect, continued to provide information about mineral wealth and geologic structures on both regional and local scales. The Bureau of Mines increased the volume of data in its computerized files for mineral deposits and land status. Bureau fieldwork centered on mining district studies, particularly in the Juneau and Glacier Bay areas. Several topical studies of gold deposits were completed, and evaluation of deposits of critical and strategic and rare-earth minerals continued. The Bureau is also involved in a major effort to use new technology in treating placer-mine effluent waters.

The National Park Service began to increase its activity in examining mining operations on Federal land. This agency and the Fish and Wildlife Service have been the principal participants in Environmental Impact Statement work for the Quartz Hill project. The Department of Agriculture has been similarly involved with work at the Greens Creek deposit. Major concerns of these agencies are mitigation of the impacts of mining.

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INTRODUCTION

Section 1011 of the Alaska National Interest Lands Conservation Act (ANILCA) of 1980 requires that "On or before October 1, 1982, and annually thereafter, the President shall transmit to Congress all pertinent public information relating to minerals in Alaska gathered by the United States Geological Survey, Bureau of Mines, and any other Federal agency." The U.S. Geological Survey has been delegated the lead agency in responding to this requirement. This circular, the fifth in the series, is a synthesis of information made public in 1985 and early 1986. This circular presents information about onshore areas of Alaska only; Outer Continental Shelf areas are not discussed.

The U.S. Geological Survey and the Bureau of Mines are the principal Federal agencies that generate information about mineral resources in Alaska. Their data and reports are used by other agencies in making decisions about land use, access, environmental impacts, and, in some instances, claim evaluation. As used herein, the term "public information" includes published results of Federal projects as they appear in U.S. Government reports or in professional and trade journals. Additional sources are talks by representatives of Federal and State agencies and industry at symposia, conferences, and other public forums, as well as proceedings volumes, press releases, and newspaper and magazine articles. Each section of this circular includes a list of cited references, and selected pertinent literature sources are listed in the final section. The Alaska Division of Geological and Geophysical Surveys and other State agencies publish an annual summary of industrial activity, data from which have been used in parts of this report.

The report is structured around two primary types of resources: energy resources (oil, gas, uranium, geothermal, coal, and peat), and nonfuel minerals, including critical and strategic minerals. Although sand and gravel are economically very important in Alaska, they are not extensively discussed in this report because their production is largely a matter of local marketing and demand rather than mineral exploration and production.

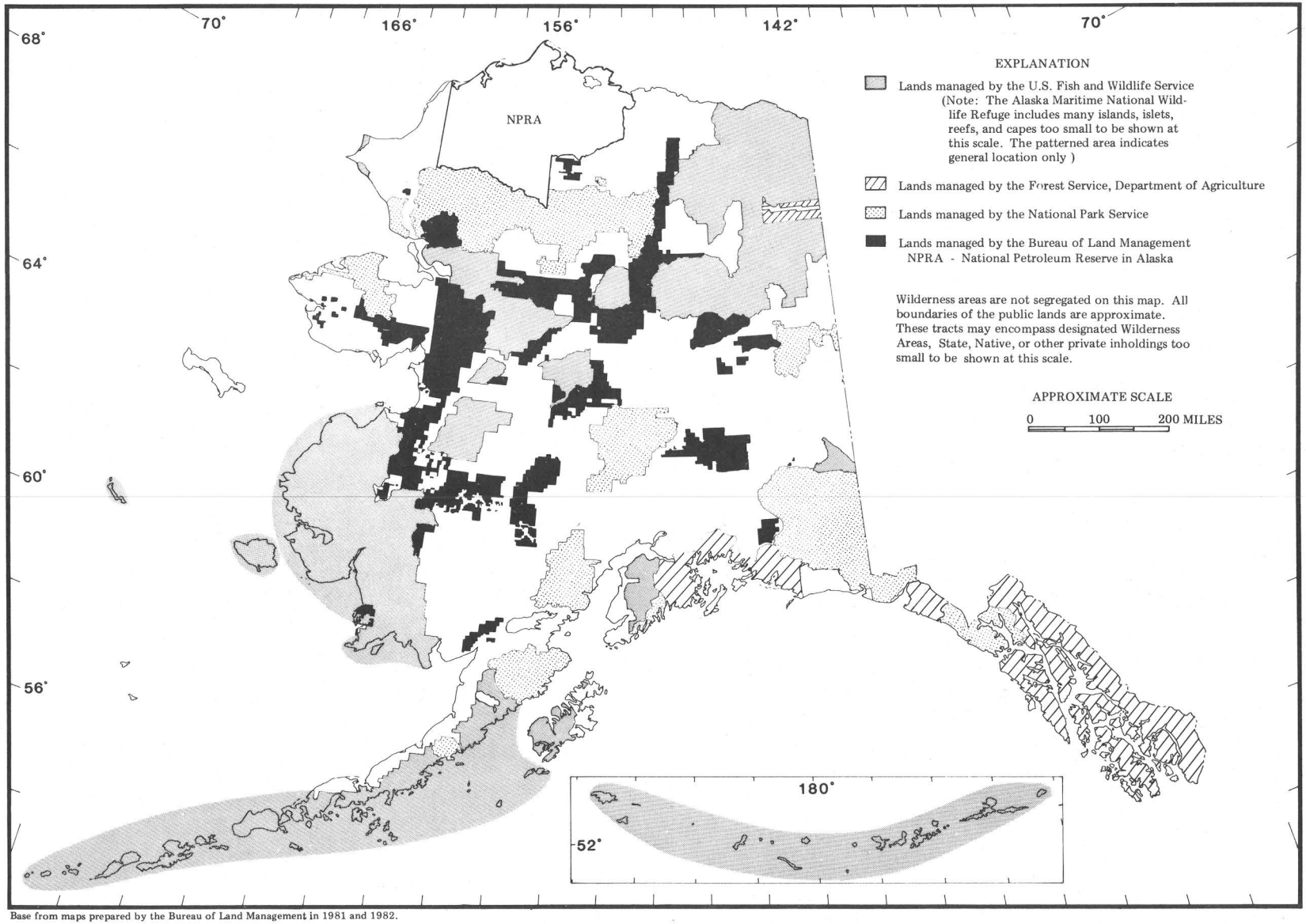
The next several pages describe the roles of land management and other Federal agencies as they relate to mineral resources, particularly in Alaska. The distribution of ANILCA conservation units is shown in figure 1.

DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

The mission of the U.S. Geological Survey is to provide information about geology, topography, and hydrology that contributes to prudent management of natural resources and promotes the well-being of people. The Survey carries out its mission through research; producing geographic, cartographic, and remotely sensed information; geologic, geochemical, and geophysical maps and studies; energy-, mineral-, and water-resource assessments; geohazards research, including toxic-waste studies; astrogeologic studies; participation in multidisciplinary projects; and publishing reports and maps, and maintaining data bases.

In Alaska, the Survey is active in assessing mineral resources, including metalliferous and energy resources. Information about domestic petroleum, coal, uranium, and geothermal resources is collected from field and laboratory research projects. In addition, Federal law requires that mineral assessments be made of areas to be set aside as wilderness and those established by ANILCA. The Alaska Mineral Resource Assessment Program (AMRAP, more fully described in the nonfuel minerals section of this report) is an example of the Survey's response to this



Base from maps prepared by the Bureau of Land Management in 1981 and 1982.

FIGURE 1.—Distribution of National Interest Lands and conservation units established by the Alaska National Interest Lands Conservation Act of 1980. Boundaries as of January 1, 1986.

legislation. The program's goal is systematic investigation of the State's metalliferous mineral resources.

Begun in 1975, AMRAP examines mineral resources at four progressively more detailed levels of study in many parts of Alaska. Levels I and II are general and cover large areas. Studies at Level III draw on many geologic disciplines to produce areal resource reports and maps at scales of 1:250,000 and 1:125,000. Nearly 30 Level III studies have been finished or are nearly complete. Thirty-nine Level IV studies were under way in 1985; these are studies of mining districts, mineral deposits, or topics related to mineral deposit genesis. Products of such studies are used to help determine distribution and quality of the national mineral and energy endowments and aid in formulating policy affecting their use and in improving technology to minimize potential hazards or impacts. These studies also help industry locate mineral deposits and assist in developing concepts, models, and techniques to identify such deposits. U.S. Geological Survey publications are frequently used by industry as a source of information about mineral deposits in the State.

The U.S. Geological Survey carries on its work in Alaska through several programs in addition to AMRAP. Among the programs active in 1985 were: (1) the Earthquake Hazards Reduction Program, which seeks to mitigate earthquake losses through providing data and evaluations for land-use planning, engineering, and emergency preparations; (2) the Volcano Hazards Program, an integrated study of volcanic hazards assessment, reduction, and prediction; (3) the Geologic Framework Program, involving both basic and specialized research; (4) studies of mineral resources on public lands, especially those under study for wilderness status; (5) the Development of Assessment Techniques Program, whose goal is improvement of the ability to identify and evaluate mineral resources; (6) the Critical and Strategic Minerals Program that seeks to identify the potential of these resources to meet national military and economic needs; (7) the Sedimentary Basins Program, which conducts studies of depositional, structural, diagenetic, and thermal processes so as to predict and evaluate water, mineral, and hydrocarbon resources; and (8) the Geothermal Investigations Program, which is intended to improve understanding of the nature, distribution, and energy potential of these resources nationally. The Trans-Alaska Crustal Transect (TACT) seeks to apply a multidisciplinary approach to studying the Earth's crust along a corridor from the Pacific Ocean to the Arctic Ocean. TACT is coordinated with the Trans-Alaska Lithosphere Investigation that includes earth scientists from the Alaska Division of Geological and Geophysical Surveys, the University of Alaska, other universities, and private industry. Many of these program activities are more fully described in later sections of this report.

The U.S. Geological Survey's Branch of Alaskan Geology has its headquarters in Anchorage and a field office in Fairbanks. Other branch geologists are stationed in Menlo Park, Calif. Alaskan seismic observatories are maintained in Adak, Barrow, Fairbanks, and Sitka.

BUREAU OF MINES

The Bureau's mission is to help assure that the Nation's mineral supplies are adequate to maintain national security, economic growth, and employment. The Bureau of Mines Alaska Field Operations Center (AFOC) has headquarters in Anchorage and offices in Juneau and Fairbanks. The AFOC carries out its mission through five programs:

(1) Minerals availability—This program is part of a worldwide Bureau program responsible for developing the Minerals Availability System (MAS) computer data base and the Mineral Industry Location System (MILS), a subset of MAS. MILS contains basic information about the identification and location of known mineral deposits. MAS is more extensive, containing information about reserve estimates, mineral extraction and beneficiation methodologies, environmental constraints to mining, and cost analyses for selected major mineral deposits. A computer and communications system allows the information to be stored, manipulated, and retrieved as computer-plotted map overlays and printouts of MAS/MILS data, enabling rapid and uniform development of cost data for MAS mineral deposit evaluations. MAS and MILS mineral deposit data are cross indexed to several other minerals information data bases.

(2) Policy analysis—This program emphasizes analyses of newly developed and existing

mineral data to interpret their significance relative to local and national mineral needs. Assessment of technical, institutional, political, social, and economical factors that affect the supply of and demand for domestic and international minerals is the key to identifying mineral issues.

(3) State mineral activities—The program provides coverage of minerals-related activities in Alaska and assists in developing and releasing nonfuel mineral industry information. The section of State Mineral Activities at the AFOC provides the Bureau direct communication with industry, the State's Division of Geological and Geophysical Surveys and Division of Mining, other minerals-oriented agencies, individuals, and private firms. The Bureau's State Mineral Officer collects, analyzes, and reports mineral data and develops information about activities and trends in the mining industry. This program produces the annual Minerals Yearbook chapters and Mineral Industry Surveys.

(4) Mineral land assessment—This is the Bureau's major Alaskan program, conducted in cooperation with State and other Federal agencies. Mineral assessments are both area and commodity oriented. Recent assessments include those for the National Petroleum Reserve in Alaska, the Chugach and Tongass National Forests, and the Kantishna Hills area in the Denali National Park and Preserve. In support of the Secretary of the Interior's commitment to assessing mineral potential of public lands in Alaska, AFOC has begun a program to evaluate mineral resources of the mining districts in the State. The first project is concentrating on the Juneau Mining District and seeks to identify the type, amount, and distribution of mineral deposits; related studies will determine ore reserves and beneficiation technologies. Studies of economic feasibility and legislative effects on mineral development will also be addressed.

A statewide program provides an inventory and specific technical evaluations of the State's critical and strategic mineral deposits on Federal lands that are closed to mineral entry and on lands open to entry that are not of current interest to industry. The Bureau also helps industry with studies of mineralogy and beneficiation of these deposits. In addition to locating, mapping, and estimating size and grade of deposits, the Bureau obtains bulk samples for metallurgical research to determine recovery and extraction methods and costs; these studies are undertaken in cooperation with Bureau Research Centers in Albany, Oreg., and Salt Lake City, Utah. Taken together, these investigations identify an inferred reserve base of marginal and submarginal deposits in Alaska and its coastal waters.

(5) Mining research—Mining research at AFOC is directly related to mineral land assessment. Bureau of Mines and university research centers cooperate with AFOC to solve mineral utilization problems. Since 1981, AFOC has worked with the Tuscaloosa (Alabama) Research Center to apply recently developed techniques to problems of turbidity in placer mine discharge water. In addition, recent studies in the Albany Research Center focused on cobalt recovery from copper deposits in interior Alaska, chromium deposits in south-central Alaska, and cobalt, nickel, and platinum-group metals in the east-central Alaska Range.

BUREAU OF LAND MANAGEMENT

The Bureau of Land Management is responsible for multiple-use management of both the surface and subsurface of 23 million acres of the National Petroleum Reserve in Alaska, plus an additional 76 million acres elsewhere in Alaska (fig. 1). The second figure changes from day to day because of the ongoing program of land conveyance to the State and Native organizations. In addition, the Bureau of Land Management administers mineral resources on approximately 100 million acres of other Federal lands, including acquired lands and private lands where the Federal government has retained the mineral rights.

In December 1984, the Bureau of Land Management revised its mineral resources policy statement to reflect the Bureau's continuing commitment to encourage private enterprise to develop domestic minerals consistent with the need for these resources. Land-use planning decisions will reflect energy and mineral values through mineral resource assessments. Public lands are generally to remain open to environmentally sound mineral exploration and development.

The principal activities of the Bureau of Land Management that are related to Alaska's onshore mineral and energy resources are (1) preparation for the scheduling of Federal oil and gas leases in the onshore areas with the concurrence of the surface management agency, (2) organization and evaluation of Federal oil and gas leases, (3) recording of mining claims and determination of validity of mining claims for mineral patents, and (4) regulation of mining activities on Bureau of Land Management lands to protect the environment. The Bureau is also responsible for enforcing the environmental and technical stipulations of the Agreement and Grant of Right of Way for the Trans-Alaska Pipeline System. The overall goal is to maintain a continuous supply of energy with minimal environmental impact. In addition, the Bureau issues land-use authorizations and conducts mineral and material sales to support preconstruction activities for the planned natural gas pipeline and other projects. Administrative responsibilities for minerals require close coordination with other surface management agencies. Generally, in the case of upland or onshore leases, the Bureau issues leases and integrates leasing with other land uses in cooperation with the surface management agency. After a lease is issued, the Bureau assumes jurisdiction of exploratory and development activities in cooperation with the land manager to assure proper surface protections.

NATIONAL PARK SERVICE

The act establishing the National Park Service (39 Stat 535) in 1916 directed it to "***consider the scenery and natural and historical objects and the wildlife***and to provide for enjoyment of the same in such a manner and by such means as will leave them unimpaired for the enjoyment of future generations." Administrative policy is based on the principles of maintaining the natural resources and on the concept that national interest dictates decisions affecting private or public enterprise in the parks. The National Park Service currently has jurisdiction over an estimated 52 million acres in Alaska (fig. 1). The main Alaskan office is in Anchorage.

The National Park Service's responsibility for mining claims and mining on park lands in Alaska and elsewhere is basically limited to mineral examinations and determinations of valid existing rights, environmental assessments of the potential impacts of mining on natural and cultural resources on Federal or other lands, protection of park resources through mining plans developed under Federal regulations, and approval of mining plans of operation. The assessments and mining plans are available for public review.

Except for validity determinations, the National Park Service rarely collects or publishes basic data about mineral deposits, commonly relying on information gathered by claimants, the U.S. Geological Survey, the Bureau of Mines, or State or private sources. Validity determinations also involve the Bureau of Land Management and the Office of Appeals and Hearings. Results of mineral examinations are made public when decisions are final.

U.S. FISH AND WILDLIFE SERVICE

The U.S. Fish and Wildlife Service provides Federal leadership to conserve, protect, and enhance fish and wildlife and their habitats for the continuing benefit of people. In Alaska, the Fish and Wildlife Service seeks to accomplish this mission through programs that implement provisions of the Endangered Species Act, Marine Mammals Protection Act, Fish and Wildlife Coordination Act, Rivers and Harbors Act, National Wildlife Refuge System Administration Act, various migratory bird laws, and other statutes. Direct activities under these laws include administration of 77 million acres of National Wildlife Refuges (NWR), fish and wildlife research, law enforcement, and habitat protection through agency review of and comments on permit requests, environmental impact statements, and other items.

Under ANILCA, 16 refuges (fig. 2) were created or enlarged to conserve fish and wildlife populations and their habitats, as well as other values. Except for valid rights existing at the time of establishment, these refuges are closed to entry and location under mining laws. The refuges are open to entry under leasing laws; however, they are closed to mining of Federal coal by the Federal Coal Leasing Amendments Act of 1975 and closed to geothermal resource leasing by the Geothermal Steam Act of 1970. While many traditional activities have been deemed appropriate for these refuges, other uses, including oil and gas leasing, will be permitted only when such activities are compatible with the purposes for which the

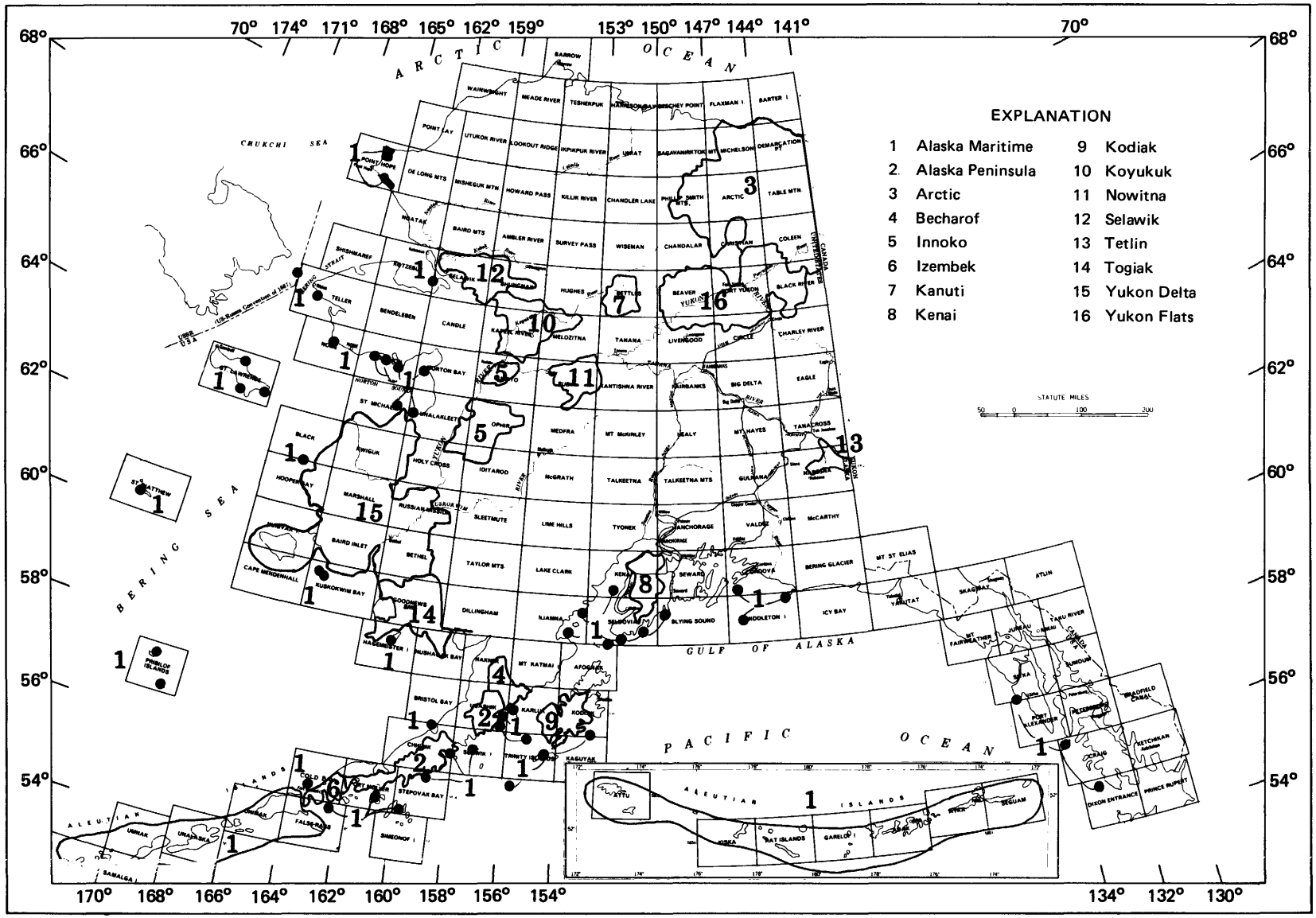


FIGURE 2.—National Wildlife Refuges in Alaska.

refuges were established. Compatible uses will be determined through a comprehensive conservation planning process under way for several Alaskan regions.

DEPARTMENT OF AGRICULTURE

FOREST SERVICE

The mission of the U.S. Forest Service of the Department of Agriculture is to provide a continuing flow of natural resource goods (including mineral and energy resources) and services to help meet National needs and contribute to meeting such needs worldwide. The U.S. Forest Service's responsibility in regard to these resources is to encourage and support environmentally sound mineral enterprises on Federal lands under its jurisdiction, consistent with other surface resource values. Under authority of the Forest Service Organic Act, the U.S. Forest Service administers regulations for the protection of surface resources from activities concerned with locatable minerals. In managing the use of these resources, it is the objective of the U.S. Forest Service that adverse environmental impacts to surface and cultural features and values that might result from lawful prospecting operations be minimized and damages be repaired. This is accomplished through the application of reasonable conditions that do not interfere with legitimate, well-planned mineral operations. The U.S. Forest Service also provides research information and technology to help with postmining reclamation. Annually, the U.S. Forest Service in Alaska provides for the disposal of millions of tons of sand, gravel, and stone.

Under a Memorandum of Understanding with the Bureau of Land Management, the U.S. Forest Service jointly admininsters the general mining laws on U.S. Forest Service lands. An example of this joint responsibility is the patent issued to U.S. Borax and Chemical Company for mining claims at their Quartz Hill deposit near Ketchikan. The U.S. Forest Service recommended issuance of this patent based on favorable findings in the mineral report prepared by U.S. Forest Service mineral examiners.

The U.S. Forest Service cooperates with Department of the Interior agencies, particularly the Bureau of Land Management, in issuing mineral leases and assuring mitigation of surface impacts of such activities. The U.S. Forest Service also cooperates with the State of Alaska and private sectors in development of energy and mineral resources on inholdings. One such inholding is the Bering River coal field, under consideration for possible development by Chugach Alaska, Inc., and others in a consortium.

The Alaska region of the U.S. Forest Service administration encompasses about 23 million acres (fig. 1). The Service's regional office is in Juneau. Offices for the Chugach Forest are in Anchorage, and for the Tongass Forest, in Juneau, Sitka, Ketchikan, and Petersburg.

DEPARTMENT OF ENERGY

It is the mission of the Federal Government to reduce the Nation's vulnerability to disruptions of energy supplies and to mitigate any adverse impacts on the Nation should a shortage occur. With regard to Alaska, the energy sources currently being addressed by the Department of Energy are fossil fuels (petroleum and coal) and geothermal.

The strategy for responding to petroleum supply interruptions is to rely on the free market, supplemented as necessary and appropriate with other measures, such as the Strategic Petroleum Reserve. With the Department mission in mind, the Department of Energy's Fossil Energy Research and Development programs are based on careful consideration of the alternatives available and the relative chances for success in fostering an adequate supply of energy at a reasonable cost through long-term, high-risk research and development. Alternatives for increasing domestic petroleum supplies include (1) the Department's Unconventional Gas Recovery program, which emphasizes the development of advanced technologies for the extraction of natural gas from resources that are classified as unconventional because of unique geologic settings and production mechanisms that are not now well understood, and (2) Department of Energy programs for developing tertiary oil recovery, tar sand, and heavy oil deposits of the United States. To develop a better understanding of both conventional and unconventional petroleum resources and to develop fundamental information to accelerate use of these resources, the Department of Energy focuses on investigating resources and technologies that continue to expand the body of essential basic scientific knowledge of conventional and heavy

petroleums, shale oil, tar sands, gas hydrates, and other deep sources of gas. Gas hydrates and deep source gas are specific targets of Department of Energy research in Alaska.

The Department of Energy is evaluating Alaskan coal in terms of its contribution to the total resources of the Nation. Coal research currently centers on utilization methods suitable to Alaskan coals and conditions.

The purpose of the Department of Energy's Geothermal Energy Program is to develop the technology needed by industry for the use of our geothermal resources. Department research is aimed toward improving our ability to locate, extract, and convert geothermal heat to usable forms of energy. In Alaska, the University of Alaska's Geophysical Institute and the Alaska Division of Geological and Geophysical Surveys received Federal funding to participate in a nationwide geothermal resource assessment (discussed in the U.S. Geological Survey Circular 892, "Assessment of low-temperature geothermal resources of the United States," published in 1983) and to contribute research data about specific geothermal systems. Through the cooperation of Federal and State agencies, a significant information base on Alaska's geothermal resources has been developed and is available to the public.

A further purpose of Department of Energy programs is to generate data essential to the private sector's decision-making process, leading to implementation of commercial projects. Therefore, several data bases are being established, including the Arctic and Offshore Technology Data Base, which is designed to provide a single computerized scientific oil and gas related information base for use by the Arctic energy community.

The Department of Energy in Alaska also administers current petroleum acts and Congressional mandates relating to energy, monitors grants, and oversees contracts for energy resource studies. Department of Energy's funding helps to support U.S. Geological Survey resource assessment studies and, as mentioned, research by the State of Alaska's Division of Geological and Geophysical Surveys and the University of Alaska.

The Energy Department's National Uranium Resource Evaluation (NURE) Program, formerly active in Alaska, has been terminated. All nonproprietary geoscience data from this program have been transferred to the U.S. Geological Survey. However, proprietary information about reserves or production are being retained by the Department's Energy Information Admininstration. Inspection of cores and cuttings can be arranged through T.C. Michalski, U.S. Geological Survey, MS 975, Box 25046, Denver Federal Center, Denver, CO 80225. Information about sample analyses can be obtained from B.R. Burger, MS 973, P.O. Box 25046, Denver Federal Center, Denver, CO 80225.

The Department of Energy has closed its regional office in Anchorage. Requests for information about the Department's Alaskan activities should be addressed to the offices listed in "Contacts for futher information."

CONTACTS FOR FURTHER INFORMATION

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Washington, D.C. 20585

OIL AND GAS

In 1985, oil and gas continued to be the most valuable mineral commodities produced in Alaska, with a total value of nearly $20 billion. Alaska's two oil-producing areas, the Arctic North Slope and Cook Inlet, provided a total of 666.2 million (42–gallon) barrels of oil, more than 206 billion cubic feet of dry natural gas, and about 1.15 billion cubic feet of casinghead gas in 1985 (Alaska Oil and Gas Conservation Commission, in press). These figures represent an increase over 1984's figures of about 5.6 percent for oil and 3 percent for dry natural gas. Production increases on the State of Alaska's North Slope leases offset production declines not only from Cook Inlet but also for the rest of the Nation as well—specifically, Alaskan oil production increased by nearly 100,000 barrels per day in 1985, mainly as a result of production increases from the Kuparuk River field, to offset production declines from the "Lower 48" of 61,600 barrels per day (World Oil, Feb. 1986). The daily rate of oil production from the entire State of Alaska at the end of 1985 amounted to 1.85 million barrels, or about 20 percent of the U.S. daily production.

A decline in the world price of oil that began in late 1985 continued into 1986. The decline, from about $30 per barrel in late December 1985, to less than $11 per barrel in earliest April 1986, was rapid and portends major readjustments for producers and consumers alike. The State of Alaska is especially vulnerable because 85 percent of the State's current revenue is derived from royalties and taxes paid on State-owned oil and gas leases (Alaska Division of Geological and Geophysical Surveys, 1986). Two recent economic studies, by the Alaska Petroleum Audit Division and the University of Alaska, demonstrate the sensitivity of North Slope oil field development and production to oil prices. (See the article by W.W. Wade in the February 1986 issue of World Oil). The validity of the conclusions of these studies appears to be reflected by the announcement of the developers of the Milne Point oil field that all drilling was halted, hiring stopped, and the capital budget drastically reduced (Anchorage Daily News, Feb. 4, 1986). Other operators are considering curtailing exploration activity, emphasizing completion of production construction instead.

Summaries of industry onshore activities have been published in the Jan. 22, 1986, issue of Petroleum Information, Alaska Report (hereafter simply Alaska Report), the Oil and Gas Journal (Aug. 5, 1985), and Pacific Oil World (Aug. 1985). Industry data for surface geologic investigations and geophysical surveys are generally obtained from private scouting services, and statistics for 1985 will not be available until late 1986. The most recent summary figures indicate increases in field crew-months of work in 1984 over previous years (Boyd and Hiles, 1985).

Industry activity for onshore Alaska in 1985 included discovery of a new oil field and startup of oil production from another field, both located on the North Slope, as well as geophysical and geological surveys and drilling of several exploratory wells and about 230 development wells. Development drilling was concentrated primarily on the North Slope in three producing and several developing fields.

Four companies, one Alaskan Native corporation, and their partners drilled 8 onshore exploratory wells in 1985, as compared to 9 in 1984 and 10 in 1983. Six of these wells are on the North Slope, and one each in the Bristol Bay and Cook Inlet basins (table 1, fig. 3). Although few data from these wells have been released, several of the

TABLE 1.—*Onshore exploratory test wells, 1985. (See fig. 3)*

Well number	Company, well name	Location (township-range -section)	Total depth (in feet)	Date completed	Remarks
		Arctic (Umiat meridian)			
1	ACC 33-1, Burglin	10N-14E-33	9,427	3/14	suspended
2	ARCO 1, Brontosaurus	18N-20W-18	6,660	3/27	P + A*
3	ARCO 26, KRU West Sak	9N-10E-11	7,300	2/27	P + A
4	Texaco 1, Colville Delta	13N-7E-17	9,457	4/10	suspended
5	Texaco 1A, Colville Delta	13N-7E-17	6,640	4/26	suspended**
6	ARCO 3, Hemi Springs Unit	9N-13E-13	10,059	4/06	P + A
		Cook Inlet (Seward meridian)			
7	ARCO/CIRI 2, Wolf Lake	7N-9W-29	14,451	2/22	P + A
		Alaska Peninsula (Seward meridian)			
8	AMOCO 1, Becharof	28S-48W-10	9,023	1/20	P + A

* Plugged and abandoned; ** Oil discovery

North Slope wells were drilled near known oil fields and have been suspended (as reported in several issues of the Alaska Report). One oil discovery was announced in the Colville River delta area, 36 miles west of Prudhoe Bay, by Texaco, Inc., and its partners Amerada Hess, Diamond Shamrock, Placid Oil, Texas Union Petroleum, Louisiana-Hunt Petroleum, and Rosewood Resources. Early in 1985, Chevron USA, Inc., Sohio Alaska Petroleum Co. (parent company now Standard Oil Co.), and BP Alaska Exploration Co. began drilling an exploratory well on Kaktovik village lands in the Arctic National Wildlife Refuge (NWR) (fig. 4), which is considered by many geologists to be the most prospective area remaining on the North Slope. The 1985 operations were suspended in May and were resumed in November after winter freezeup. Drilling continued into 1986.

A second winter seismic survey of the coastal plain of the Arctic NWR was completed by Geophysical Service, Inc., a subsidiary of Texas Instruments, for a group of oil companies. This survey will provide infill data to the 1984 survey and more detailed information about the petroleum potential of the area than is available from surface studies alone. (See the paragraphs describing the U.S. Fish and Wildlife Service activity during 1985.)

The Prudhoe Bay field (fig. 3), the world's 19th largest oil field (Tiratsoo, 1984), continues to produce about 1.5 million barrels of oil per day. A seawater treatment plant, installed in 1984, injects about 1.3 million barrels per day of water into the producing reservoir to increase the amount of oil recovered (Alaska Report, Jan. 22, 1986).

In the Kuparuk River oil field (fig. 3), the Nation's second largest producer, the unit area was increased by nearly 13,000 acres in 1985. Seawater injection, which amounted to about 400,000 barrels per day at yearend, is expected to triple the amount of oil recoverable—from 500 million barrels to 1.5 billion barrels. Cumulative oil production in January 1986 reached 200 million barrels, and daily production was about 240,000

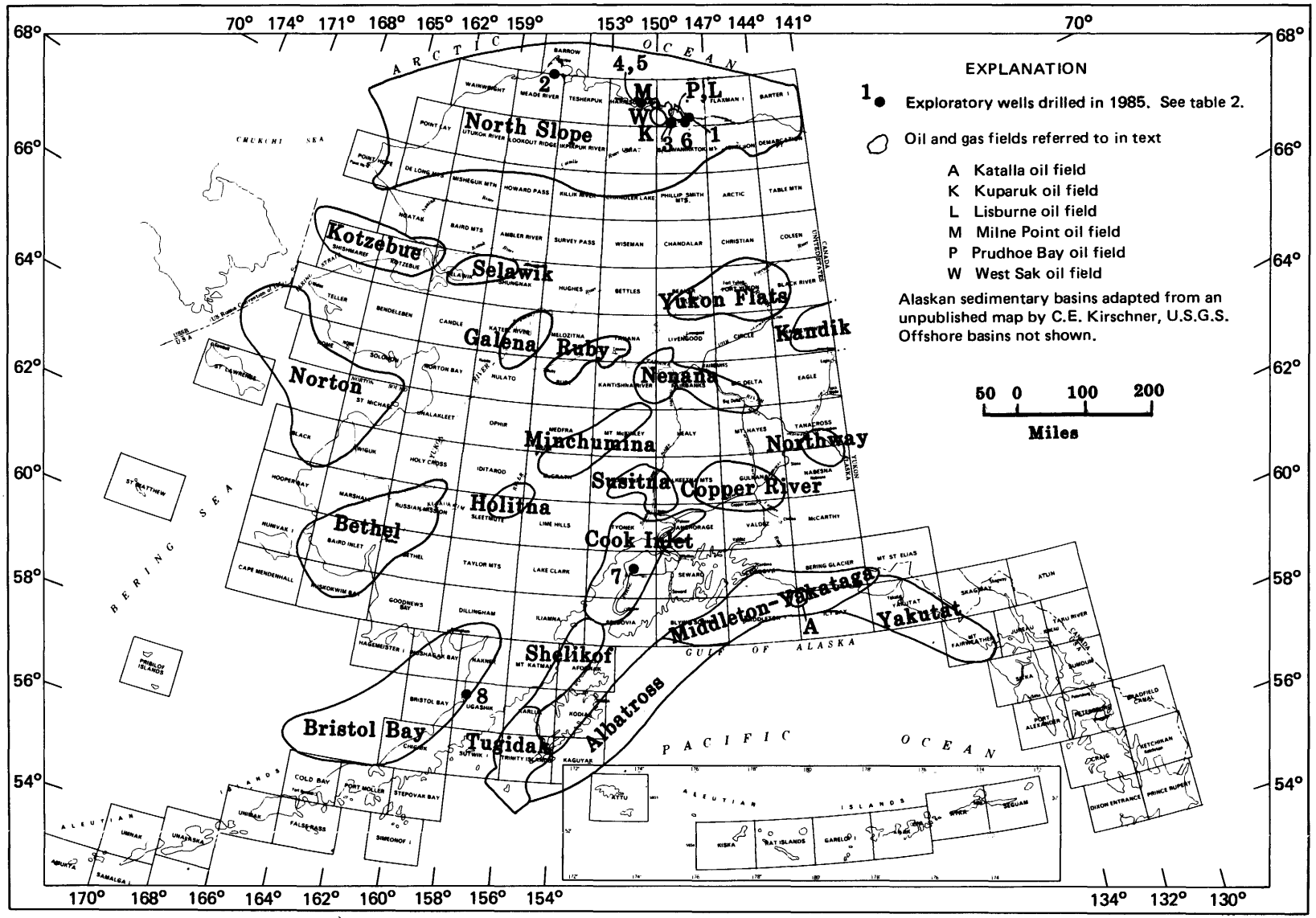

FIGURE 3.—Locations of exploratory wells drilled in 1985, oil and gas fields, and Alaskan onshore and nearshore sedimentary basins.

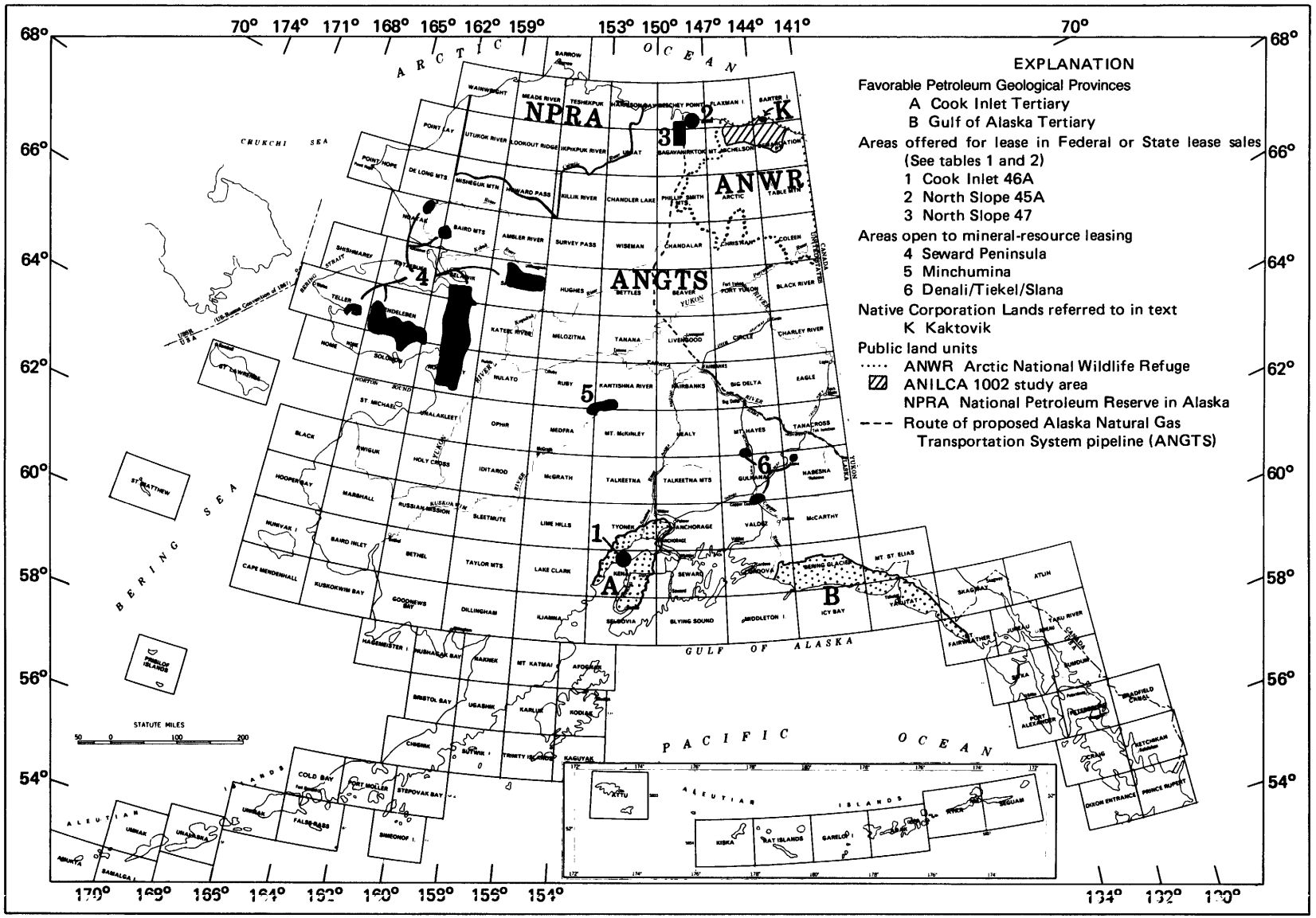

FIGURE 4.—Favorable Petroleum Geological Provinces, areas offered for lease, Arctic National Wildlife Refuge study area, Native and public land units referred to in text, and proposed gas line route.

barrels. A record production level of 264,490 barrels of oil per day was announced by ARCO Alaska, Inc., in early November. This rate exceeds the expected peak production level of 250,000 barrels per day, which was not anticipated until late 1986 (Alaska Journal of Commerce and Pacific Rim Reporter, Nov. 11, 1985). This increase in production was in part responsible for the 5.6-percent increase in Alaskan oil production in 1985 and for the highest U.S. oil production level recorded since 1974 (World Oil, Aug. 1, 1985). Major owners of the Kuparuk field are ARCO Alaska Inc., BP Alaska Exploration Co., Sohio Alaska Petroleum Co. (now Standard Alaska Production Co.), and Union Oil Co. of California. Minor interest owners are Exxon Co. U.S.A., Mobil Oil Corp., Phillips Petroleum Co., and Chevron USA, Inc.

In late 1985, the Milne Point oil field (fig. 3) began production, ahead of schedule and only 21 months after project startup. Reservoir conditions have limited oil production to about 20,000 barrels per day, about two-thirds of the expected rate (Anchorage Daily News, Feb. 4, 1986). Current operations include production from 20 wells and water injection at 11 wells (Oil and Gas Journal, Nov. 25, 1985). Further development is planned, subject to economic conditions, according to Conoco, Inc., and partners (Champlin Petroleum Co., Cities Service Oil and Gas Co., Chevron USA, Inc., and Reading and Bates Petroleum Co.).

ARCO Alaska, Inc., proceeded with development work on the Lisburne oil pool, which underlies the northeastern part of the Prudhoe Bay field (fig. 3) and is estimated to contain from 1 billion to 3 billion barrels of oil in place. Development work consisted of gravel road and pad construction, production well drilling, and fabrication of production facilities. ARCO reported that two long-term production test wells produced more than a million barrels of oil during 1985 (Alaska Report, Jan. 22, 1986). Ownership of the field is split among ARCO, Exxon Co. USA, and Standard Alaska Production Co.

ARCO Alaska, Inc., continued its pilot project begun in 1984 to determine the producibility of the multibillion barrel heavy-oil accumulation known as West Sak (fig. 3). This oil accumulation overlies the Kuparuk River oil field at depths of 3,000–4,000 feet. The project consists of injecting hot water into the reservoir to heat the oil sufficiently to reduce its viscosity, thus making it easier to produce. Oil production is about 1,000 barrels per day from eight test wells (Pacific Oil World, Aug. 1985). The shallow depth of the oil and poorly consolidated reservoir sands will necessitate many wells and special production techniques, making this a very expensive field to develop (Alaska Journal of Commerce and Pacific Rim Reporter, Mar. 11, 1985).

Alaska's first, but long-abandoned oil field, Katalla, located in the Gulf of Alaska basin (fig. 3), may soon be revived. Alaska Crude Corporation has received permits for 10 shallow production wells. The corporation estimates that as many as 30 wells will be drilled to recover about 3 million barrels of oil (Alaska Report, Dec. 31, 1985).

At the three 1985 competitive State lease sales, a total of $18.83 million was offered in high bids to acquire about 538,000 acres for future exploration. At least nine oil companies and several lease brokers representing numerous individual investors participated in one or more of the three sales. Information about the sales is summarized in table 2, and the lease sale areas are shown in figure 4. The terms of the 1985 leases, all of which are on State lands, can be obtained from the Lease Administration Office, Alaska Department of Natural Resources, 3601 C Street, Anchorage, AK 99503. For further information about State petroleum-related activities, readers should contact the Alaska Division of Oil and Gas, 3601 C Street, Anchorage, AK 99503, or consult the Alaska Department of Natural Resources Information Circular 31, Oil-and-gas resources of Alaska (Alaska Division of Geological and Geophysical Surveys, 1986); this publication

TABLE 2.—*Onshore oil and gas lease sales, 1985.* [Areas shown in fig. 4; all sales were conducted by the State of Alaska, and most of the area offered in sales 1 and 2 was offshore; value of high bids in millions of dollars]

Area no.	Sale no.	Sale date	Acres offered (x 1000)	Acres bid on (x 1000)	Total high bids
1	46A	2/26	248	190	2.52
2	45A	9/24	193	183	11.65
3	47	9/24	606	165	4.66

provides an illustrated summary of the history, current prospects, resource estimates, and leasing program for oil and gas in Alaska.

ACTIVITY BY FEDERAL AGENCIES

During 1985 and continuing into 1986, Federal agencies carried on their required activities, monitoring and supervising lease development, collecting rent on leases and royalties on production, and performing numerous geologic and geophysical studies relating to oil and gas resource evaluation and land classification.

Bureau of Land Management

In establishing and implementing an oil and gas leasing program as required by Section 1008 of ANILCA, the Bureau of Land Management has made land available for noncompetitive oil and gas leasing or mineral leasing in three areas south of lat. 68° N. The Minchumina area was opened in 1981, the Denali-Tiekel area in 1982, and the Seward Peninsula in 1983. As of March 31, 1986, about 385 leases on 94,450 acres in the Minchumina area, 5,168 leases on 1,841,000 acres of the Denali-Tiekel-Slana area, and 1,760 leases on 1,153,500 acres on the Seward Peninsula were being held. The general lease areas are shown in figure 4; at this map scale it is not possible to indicate precisely the leased portions of these areas.

A fifth lease sale in the National Petroleum Reserve in Alaska (NPRA) (fig. 4) had been planned for August 1985. Because no bids had been received for the fourth sale in July 1984, the Bureau initiated a study to determine the need for a fifth sale. Among the issues analyzed were market and economic conditions, geology and drilling data, industry interest, surface management, and litigation. After considering all these factors, the Bureau decided to postpone the 1985 sale for at least 1 year.

The Bureau is transferring lands in the utility corridor between the Yukon River and Washington Creek to the State of Alaska. The Bureau will begin preparing a Resource Management Plan in FY 1986 for the corridor and adjacent Bureau-administered lands north of the Yukon River. The planning effort will follow the Bureau's planning process and will have public input.

The annual report of the Bureau's Branch of Pipeline Monitoring is available through the Public Affairs Office in the Anchorage Federal Building. This Branch, part of the Bureau's Division of Mineral Resources, assures that terms and conditions of the Alyeska Pipeline Service Company's pipeline right-of-way are met.

The Bureau's involvement with the Northwest Alaska Pipeline Company's proposed natural gas pipeline project (ANGTS, fig. 4) remains at a low level because the project is delayed. The Yukon Pacific Corporation submitted a right-of-way application to the Bureau for a gas pipeline from Prudhoe Bay to tidewater, possibly near Kenai. The Bureau has responsibility for processing this application. The viability of both pipeline projects is linked to worldwide demand and price for natural gas.

U.S. Fish and Wildlife Service

As noted in the introductory pages of this report, the primary efforts of the agency in Alaska are protection and conservation of fish and wildlife and their habitats and the administration of 16 refuges (NWRs) (fig. 2). The Service also cooperates with State and Federal agencies in similar efforts on behalf of wildlife in the rest of the State. Any oil- or gas-related activities on refuges are subject to restrictions and protective stipulations developed by the Service.

On the Kenai NWR in 1985, some oil wells were reworked to maintain production at Swanson River, Alaska's first commercial field. From the Beaver Creek field, maximum gas production has probably been reached. Chevron USA, Inc., operator at Swanson River, entered an agreement with the Environmental Protection Agency (EPA), arranged with the assistance of the Fish and Wildlife Service, for the cleanup of PCB-contaminated materials inadvertently used on some parking areas and roads for dust control. This agreement is the first in the U.S. regarding cleanup from a NWR of a substance identified as hazardous by the EPA.

Exploration-related surface activities on the Arctic NWR coastal plain continued under the Service's surveillance as provided for in Section 1002 of ANILCA, which mandates an assessment of fish and wildlife resources and potential impact of petroleum exploration, development and production in the area. Section 1002 (c) authorizes a

baseline study of biological and human resources. Section 1002 (d–g) calls for limited petroleum exploration. The Fish and Wildlife Service is the overall coordinator of the Section 1002 resource assessment. That agency, the Bureau of Land Management and the U.S. Geological Survey have a Memorandum of Understanding regarding exploration in the refuge. The exploration program allows private industry to gather data about the area's petroleum potential. In accordance with Service regulations promulgated in 1983, six permittees were allowed to conduct surface geological field studies in the summer of 1985, the third summer of such work. No surface vehicles were allowed; access was by helicopter. The work involved observations, measurements, mapping, and sample collection. Rock samples were analyzed for age and geochemistry (hydrocarbon generation potential) and porosity and permeability (reservoir characteristics). The Fish and Wildlife Service monitored all activities, and no adverse impacts to fish or wildlife were observed.

The Service also approved a second winter season of seismic exploration on the coastal plain. The single permittee, Geophysical Service, Inc., was authorized to collect 580 line miles of infill data, the amount of additional information believed necessary to develop a credible hydrocarbon assessment of the coastal plain. A total of 537 line miles was run. The Fish and Wildlife Service placed monitors with each seismic crew to help minimize environmental impacts.

An interagency advisory work group made up of Fish and Wildlife Service, Bureau of Land Management, and U.S. Geological Survey employees is overseeing the preparation of the report to Congress that is mandated by Section 1002 (h). This report is scheduled for completion in September 1986. Its purpose is to help Congress weigh the hydrocarbon potential of the area and the need for additional domestic sources of oil and gas against the enviromental consequences of allowing petroleum development.

Section 1008 of ANILCA provides for oil and gas exploration on refuges in Alaska to provide information for use in future land managment decisions. In 1985, special-use permits were issued for surface geological work on the Alaska Maritime, Alaska Peninsula, Arctic, Becharof, and Yukon Flats NWRs (fig. 2); $10,000 bonds are required with these permits. Copies of data resulting from such exploration must be submitted to the Fish and Wildlife Service; they are stored with the Bureau of Land Management.

Section 1008 also calls for establishing a program for oil and gas leases of land south of lat. 68° N., pursuant to the Mineral Leasing Act of 1920 as amended. The program does not apply to those NWR lands where the Secretary of the Interior determines that oil and gas exploration or development would be incompatible with the purpose of the refuge. Section 314 (g) of ANILCA cites the comprehensive conservation planning process as the means of identifying parts of NWRs where leasing or related activities may be compatible. During 1985, this planning process began on the Alaska Maritime, Arctic, Innoko, and Selawik NWRs. First steps in the process involve defining the limits of the study and the form and content of the report and collection of related data. Then alternatives are drawn up. A draft of the plan is released for a 90–day period of public review. Final plans were issued for the Alaska Peninsula NWR and, with Records of Decision, for the Becharof, Izembek, and Kenai NWRs. Draft plans were released for Kodiak, Tetlin, Togiak, and Yukon Flats NWRs in 1985; final versions are scheduled for 1986. Public releases of drafts are scheduled for 1986 for the Arctic, Kanuti, Koyukuk, Nowitna, Selawik, and Yukon Delta NWRs. (See fig. 2 for NWR locations). The Bristol Bay Regional Management Plan was submitted to the Department of the Interior in 1985.

If refuge lands are to be leased by the Bureau of Land Management, the leases will be competitive if the land is in a Favorable Petroleum Geological Province (fig. 4), or noncompetitive if not within such a province. All leasing, exploration, and production would be subject to permits and stipulations designed to protect fish, wildlife, and subsistence activities.

Fish and Wildlife Service mineral-related activity includes making recommendations for mitigating impacts adverse to fish, wildlife, and their habitats. Therefore, the Service reviews Corps of Engineers permit applications under Section 404 of the Clean Water Act; the applications may involve public or private lands. As a result of Section 404 permit negotiations with Standard Alaska Production Co. (formerly Sohio Alaska Petroleum Co.) and ARCO Alaska, Inc., concerning the offshore part of the Lisburne Project, a letter of agreement was received from each company stating their intent to prepare mitigation

plans in consultation with the Fish and Wildlife Service.

With the Alaska Department of Fish and Game and the Bureau of Land Management, the Service entered a memorandum of agreement for joint development of a Habitat Management Plan for the Teshekpuk Lake Special Area in the northeastern part of NPRA. This area, which is potentially available for leasing, is one of the most productive and diverse wetland ecosystems in arctic Alaska.

In May 1985, the Fish and Wildlife Service, with the Alaska Association of Petroleum Landmen, sponsored a two-day conference for exchange of information and views about mitigation of impacts to fish and wildlife from petroleum development in Alaska. The conference was attended by persons in industry and government. Papers presented have been compiled by Wohl (1985). Although disagreements persisted, the conference resulted in communication among the participants, and the Service plans to foster additional meetings.

Department of Energy

The Arctic and Offshore Research Subprogram of the Department of Energy's Advanced Process Technology Program was established to enhance petroleum energy development by quantifying critical natural forces (such as ice formation in the Arctic) and their impacts and to establish a data base for Arctic parameters. Much of the subprogram's efforts are directed at offshore development; onshore objectives involve enhanced oil recovery and study of heavy oil, oil shale, and tar sands. In 1985, Department petroleum-related work was carried on through initiating a technology data base, sponsoring seminars, coordinating interagency research, and delineating, as well as examining the applicability of recovery techniques to Arctic petroleum occurrences.

A primary petroleum target is gas hydrate reservoirs, which contain gas in a solid, icelike form. Occurrences of such hydrates have been identified on Alaska's North Slope. The technology for characterizing and developing the resource is under study as part of the Department's Environmental and Advanced Research Subprogram. The subprogram has recently been concentrating on laboratory testing of natural and synthetic hydrates to define pressure and temperature conditions and geophysical and mechanical properties in both in-house and contractors' facilities.

The Department's deep source gas research is evaluating the potential for recovering gas from depths greater than 30,000 feet, based on the hypothesis that natural gas would be generated in sediments carried to these depths by tectonic processes. Primary targets are subduction zones where suitable sediments have been encapsulated. Among such areas is the Yukon Flats area (in the Fairbanks area), where cooperative stratigraphic, structural and magnetotelluric studies are under way. (Further details are provided in the following section.) The Department of Energy has also sponsored, through the University of Alaska, a search for such gas sources in south-central and southwestern Alaska.

U.S. Geological Survey

The North Slope continues to be the focus of most U.S. Geological Survey studies related to onshore oil and gas resources; many of the studies are part of the Sedimentary Basins Program or the Alaska Mineral Resource Assessment Program. The paragraphs below summarize recent activities. Selected pertinent reports are listed with the U.S. Geological Survey publications and other references at the back of this report.

The operational phase of the Federal petroleum exploration program in the NPRA was completed in 1981. A nontechnical report (Gryc, 1985) describes this program. Meanwhile, more than 30 technical reports by Survey scientists are nearing completion for publication as U.S. Geological Survey Professional Paper 1399. Topics to be included are stratigraphy, sedimentation, seismic stratigraphy, petrography, paleontology, biostratigraphy, petroleum source-rock geochemistry, structural geology, direct hydrocarbon detection by aeromagnetic and helium methods, assessment results, and exploration history. Most data from the 1974–81 exploration program, as well as numerous pertinent contractor reports, are available to the public through the National Geophysical and Solar-Terrestrial Data Center, Boulder, CO 80303. Their catalog itemizes information about 38 wells, 14,770 line miles of reflection seismic surveys, 52,000 gravity measurements, and numerous reports about geology, geophysics, the environment, construction, and logistics.

Numerous talks or poster sessions concerning geologic aspects of Alaskan oil and gas sources were presented at the regional meeting of the American Association of Petroleum Geologists (AAPG), Society of Economic Paleontologists and Mineralogists (SEPM), and Society of Exploration Geophysicists (SEG) held in Anchorage in 1985. Abstracts of these presentations were published in the American Association of Petroleum Geologists Bulletin (1985, v. 69, no. 4, p. 655–683).

A collection of seven papers about the geology of the Nanushuk Group was published in 1985 (Huffman, 1985). The papers treat the petrography and reservoir characteristics, stratigraphy, sedimentation, tectonics, and paleontology of these Cretaceous rocks in the central part of the North Slope.

The study of naturally occurring gas hydrates on the North Slope, funded by the Department of Energy, progressed on several fronts during 1985. Topics of publications or talks include: identification of gas hydrates using well logs (Collett and others, 1984); determination of permafrost thickness from well logs (Osterkamp and others, 1985); evaluation of geothermal gradients (Collett, 1985a); geologic control of hydrate occurrence (Collett, 1985b); and regional stratigraphic relations (Collett and others, 1985). In progress are investigations to determine the compositions of natural gases on the North Slope and the characteristics of potential gas-hydrate reservoir rocks.

With funding from the Department of Energy, Geological Survey and university scientists conducted studies in the eastern Brooks Range and Charley River-Eagle area (along the Canada-Alaska boundary) with the goal of projecting established geologic relations into the swampy lowlands of the Yukon Flats to evaluate the potential of that region for generating and trapping deep gas resources. This study is part of a larger effort to evaluate the potential for the occurrence of deeply buried petroleum resources along ancient convergent continental margins where obduction processes have been dominant. Field mapping and paleontologic and geochemical studies have shown new age and structural relations in these geologically complex areas in which several accreted terranes are now recognized. General characteristics of these terranes are described by Coney and Jones (1985).

During 1985, geologists of the U.S. Geological Survey and Bureau of Land Management completed summer field studies in the Arctic NWR and, later in the year, met to jointly assess the undiscovered oil and gas resources of the ANILCA 1002 (coastal plain) area. This assessment marks the culmination of several years of geologic and geophysical studies by both agencies. As noted above, the required report to Congress is being drafted by members of the Fish and Wildlife Service, Bureau of Land Management, and the U.S. Geological Survey.

Results of two U.S. Geological Survey studies have recently been made available. U.S. Geological Survey Bulletin 1596, edited by L.B. Magoon, is a collection of eleven papers about geologic studies related to the lower Cook Inlet COST well; this bulletin was in press in April 1986. The other publication, "American Association of Petroleum Geologists Special Studies in Geology 20", edited by Magoon and Claypool (1985), presents the results of studies by research groups from industry, academia, and government that have been investigating the correlation of North Slope petroleum source rocks with known North Slope oils.

Survey scientists continued their project to summarize the geology and evaluate the petroleum potential of all interior Alaska basins (those south of the North Slope and generally north of Cook Inlet as shown on fig. 4) during 1985. A 6–week helicopter-supported field program focused on the stratigraphy, sedimentology, and petroleum source-rock potential of Tertiary fluvial and lacustrine deposits in the Nenana and Susitna basins (fig. 4). Preliminary gravity maps and accompanying structural models of the Nenana and Yukon Flats basins were presented at the AAPG-SEPM-SEG meeting in Anchorage (Kirschner and others, 1985).

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COAL AND PEAT

Alaska's coal prospects are favorable, despite falling world energy prices, and Alaskan coal fields have many features that contribute to a hopeful outlook for coal development and export. Alaska's coal resource base is estimated at 1,886 billion short tons, approximately half of the U.S. resource base and probably one-sixth of the total world resource base (Alaska Division of Geological and Geophysical Surveys, 1983). In addition, many Alaskan coals have low sulfur contents; for example, coal from the Beluga coal field has a total sulfur range of 0.08–0.33 percent, one of the lowest reported ranges for any U.S. coal (Stricker and others, 1986). The proximity to tidewater of several of the State's coal fields (U.S. Geological Survey, 1982, fig. 5) makes the economics of development attractive. And, when compared to other suppliers of coal to the Pacific region countries, Alaska has a more stable political and labor environment (Alaska Economic Report, Aug. 11, 1985).

During 1985 industrial activity was focused on five Alaskan coal fields: Beluga, Bering River, Jarvis Creek, Matanuska Valley, and Healy (fig. 5). The Alaska Journal of Commerce and Pacific Rim Reporter (Oct. 28, 1985) noted that the Diamond Alaska Coal Company has finished preliminary drilling in the Beluga field and will soon submit plans for a surface mine there and a loading dock in Cook Inlet. The company proposes initial export of 2 million short tons annually, building to a maximum annual production of 4 million short tons. Construction could begin as early as 1987. Diamond Alaska is also considering building an electrical powerplant that would supply not only its mining power needs but also allow it to offer its surplus electricity to utility companies in south-central Alaska. Initial projections put the cost per kilowatt hour higher than current gas-powered electricity, but Diamond Alaska believes that in the 1990's coal might be a cheaper power source (Anchorage Times, Feb. 2, 1986).

An article in the Alaska Journal of Commerce and Pacific Rim Reporter (July 8, 1985) noted that Chugach Alaska Corp. planned to drill a total of 17,000 feet in the Bering River coal field in 1985. The low-volatile bituminous to anthracite coal there is present in five major seams, and resources are estimated at 59 million short tons. The permitting process should begin in 1986 and would take at least three years. Current plans call for this coal to be exported to Korea or other Pacific region countries. Also encouraging is a report (Alaska Journal of Commerce and Pacific Rim Reporter, Aug. 8, 1985) that notes that coal from the Jarvis Creek coal field may be developed to produce coal gas, which in turn would be used to

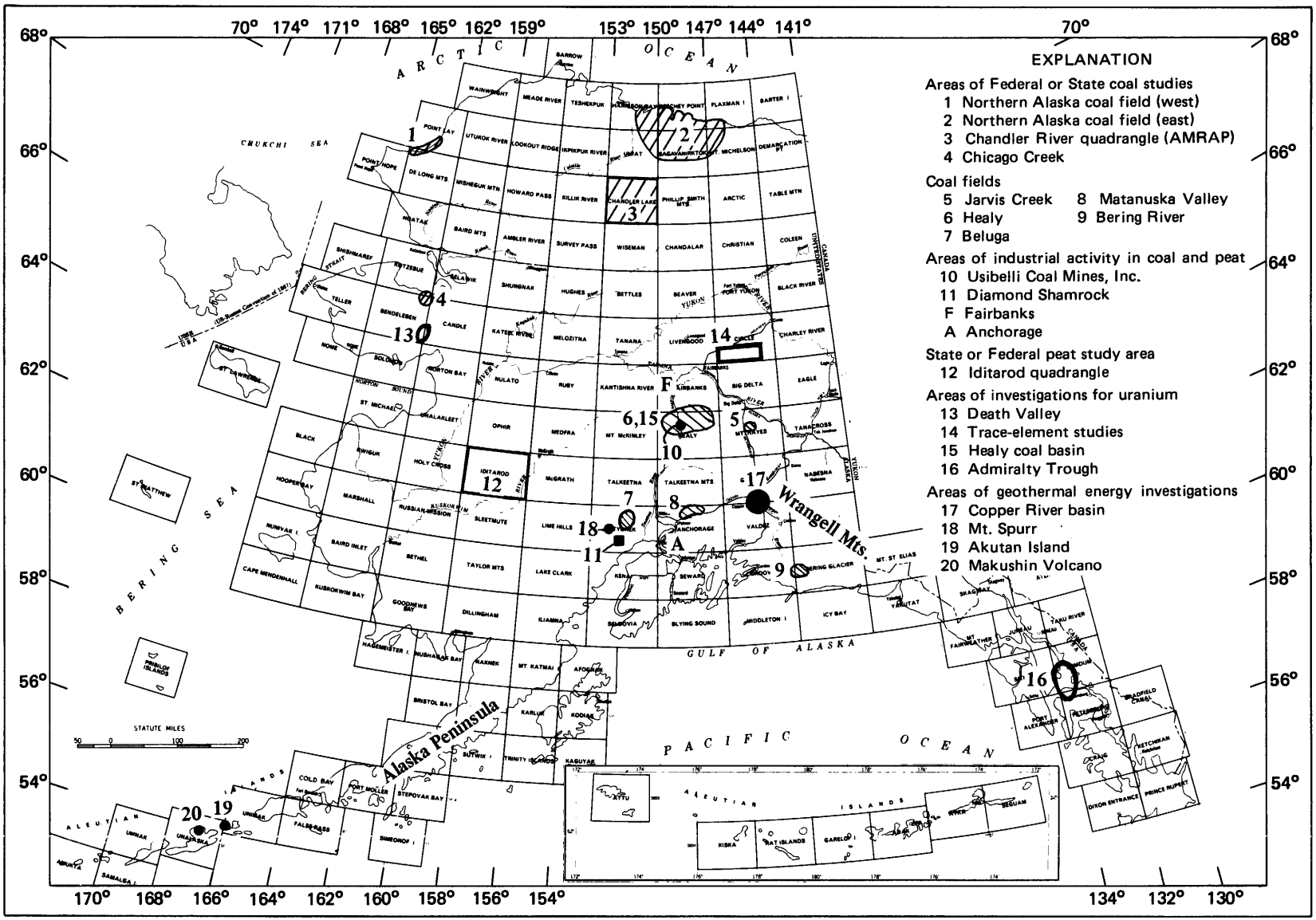

FIGURE 5.—Areas of Federal, State, and industry activity for coal and peat, uranium, and geothermal resources, 1985.

generate electrical power for the Fort Greely military base near Delta Junction. The coal has a low sulfur content (0.42–1.5 percent) and an apparent rank of subbituminous B and subbituminous C. The joint-venture partnership of Hawley Resources, Rocky Mountain Energy, Signal Energy Systems, and Cook Inlet Regional, Inc., has been planning a $420–million coal mine and 170–megawatt electrical generating plant in south-central Alaska. Approximately 25 years of reserves of bituminous coal are present on the State of Alaska lease in the Matanuska Valley. The Alaska Economic Report (Sept. 9, 1985) stated, at that time, uncertainty about the Susitna River hydroelectric project was delaying the coal-powered electric generating project for Matanuska coal; State support for the Susitna project was withdrawn in March 1986.

Alaska's coal production in 1985 was significantly higher than in 1984. The Usibelli Coal Mine, Alaska's only active coal mine (Healy coal field, fig. 5), produced more than 1.3 million short tons of coal by surface mining and exported 595,000 short tons of this total to South Korea for steam production (Anchorage Daily News, Nov. 11, 1985). The coal was transported in 138 train shipments to Seward, where it was put aboard ships bound for Korea.

The Alaska Division of Geological and Geophysical Surveys (ADGGS) continued exploration in the Chicago Creek coal field on the Seward Peninsula (fig. 5). The coal will probably by used in nearby villages for heat; the feasibility of mining and transportation to the local use site, as well as of a powerplant, are being investigated. The Alaska Journal of Commerce and Pacific Rim Reporter (Aug. 8, 1985) reported that the State of Alaska is also evaluating the coal potential of the Cape Beaufort and Deadfall Syncline areas in the western part of the Northern Alaska coal field (fig. 5). Coal there is reported to have low sulfur content (0.06–0.64 percent) and heat values as high as 12,000 Btu. It is estimated that there are 15.8 million short tons of strippable coal for local village needs and as a power source for the proposed Red Dog mine development (discussed more fully in the nonfuel minerals section of this report).

Peat in Alaska is used primarily in agriculture and greenhouses as soil conditioners; minor amounts are used locally in villages for heat. Because of a general slump in housing construction statewide, production was only 85,000 cubic yards, or about 42 percent less than in 1984 (Bundtzen and others, 1986). About 80 percent of Alaska's horticultural peat is produced in the Anchorage area.

Table 3, in the section discussing nonfuel minerals, lists volume and value of coal and peat production for recent years.

ACTIVITY BY FEDERAL AGENCIES

U.S. Geological Survey

The Geological Survey investigated the quality and quantity of coal in the Chandler Lake 1:250,000–scale quadrangle (fig. 5) in the southeastern part of the Northern Alaska coal field as part of the Alaska Mineral Resource Assessment Program (AMRAP). Coal is present in the flanks of east-west-trending synclines and anticlines in the northern one-third of the quadrangle. Preliminary results indicate that the coal has low contents of sulfur (0.13–0.56 percent) and ash (2.7–15.4 percent) and an apparent rank of high-volatile bituminous A to high-volatile bituminous C.

Tertiary coal in the eastern part of the Northern Alaska coal field (fig. 5) is being studied as part of the Survey's Sedimentary Basins program (briefly described in the introductory pages of this report). Preliminary results suggest that the coal along the Sagavanirktok and Shaviovik Rivers has a low sulfur content (0.11–1.42 percent) and an apparent rank of lignite A to subbituminous B (Molenaar and others, 1984). Work on estimating the size of the resource and defining the depositional environment is under way.

Detailed geochemical and mineralogic studies to characterize the coals from the Beluga resource area continue. This information will provide background data for future coal development that the Diamond Alaska Coal Company proposes for the area. The coal has an apparent rank of subbituminous C to subbituminous B and an ash content that ranges from 4.7 percent to 46.5 percent. The ash is composed primarily of kaolinite, but it contains minor amounts of other clays and varied amounts of quartz; definition of the type and amount of ash is critical to the design of the plant that will use the coal.

The U.S. Geological Survey has been investigating the Iditarod 1:250,000–scale quadrangle

(fig. 5) as part of its AMRAP program. Preliminary studies indicate that the area contains significant amounts of blanket peat deposits of good quality, in beds as thick as 5 feet and having a low (less than 5 percent) ash content.

Bureau of Land Management

The Bureau of Land Management continued its management of the Delta Coal Company lease in the Jarvis Creek coal field near Delta Junction (fig. 5). Coal in this field is a potential power source for Fort Greely. Interest in additional future coal leasing on Federal land is low at this time.

Department of Energy

The Department is examining coal resources in Alaska as part of its Arctic and Offshore Research Subprogram. The goal of the subprogram is to evaluate coal in terms of its contribution to the National resource base. The Department of Energy is also actively studying coalbed methane on a nationwide basis, and it has sponsored, through the University of Alaska, research projects that investigate means of liquefying certain Alaskan coals and the beneficiation potential of coals crushed to various fragment sizes.

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URANIUM RESOURCES

A slump in the demand for uranium in the United States and a surplus of relatively cheap uranium from foreign countries, especially from Canada, France, and Australia, continue to depress the domestic uranium industry. Funds for research in uranium geology are very restricted both in industry and among domestic Federal agencies. Uranium mining and development in the United States is limited to high-grade deposits or those (such as surficial deposits) from which production is relatively cheap. Current uranium exploration is limited to searches for this type of deposit (Otton, 1986). The uranium picture in Alaska is even less promising because costs of exploration and development are higher than those in the conterminous States. However, many areas in Alaska are favorable for low-radiation surficial uranium deposits. These deposits are generally in young, organic-rich alluvium on or near uraniferous granite plutons or other uranium sources. Little exploration for this kind of deposit has been undertaken, and no deposits have yet been found.

In 1985, the U.S. Department of Energy declared the uranium industry in the United States nonviable for the 1984 calendar year. This finding requires that the Administration take action, such as import restrictions, to protect the domestic uranium industry. In Denver Federal Court, in a suit filed by uranium producers, Department of Energy contracts to enrich foreign-produced uranium for use by domestic facilities were declared null and void. The outcome of this action remains uncertain.

ACTIVITY BY FEDERAL AGENCIES

U.S. Geological Survey

Uranium and tin occurrences in the Circle quadrangle (east-central Alaska, fig. 5) have been studied by Jones and others (1985). They used statistical discrimination on trace element analyses of stream-sediment samples to distinguish between areas favorable for tin and uranium. They

found that niobium and scandium are indicator elements for uranium-enriched areas.

The uranium potential of the Cretaceous Nanushuk Group on the North Slope has been evaluated by Huffman (1985). No uranium-rich rocks were found, but Huffman described the rocks as marginally suitable for uranium on the basis of such factors as depositional environment, hydrologic characteristics, host rock texture, presence of potential uranium sources in the surrounding areas, and carbonaceous material (a chemical reductant) in the potential host rocks. The easternmost part of the North Slope, now being evaluated, appears to have somewhat more uranium potential than the remainder of that area.

The U.S. Geological Survey has terminated its project on uranium in sedimentary rocks in Alaska, but it will continue ongoing uranium research in other parts of Alaska. Areas currently being studied include the Death Valley uranium area in the southern part of the Seward Peninsula, the Healy Creek coal basin on the north side of the Alaska Range, and the northern part of the Admiralty Trough in southeastern Alaska (fig. 5). Present work consists of laboratory analyses and report preparation. Additional fieldwork in Alaska will depend on funding.

Department of Energy

Information Systems Programs, Energy Resources Institute (1985), on behalf of the Department of Energy, released a report on uranium in Alaska that summarizes data from stream-sediment and water samples for all Alaskan quadrangles that were part of the NURE program studies.

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GEOTHERMAL RESOURCES

Primary use of Alaska's geothermal resources is for recreation, space heating, and agriculture, but this use is highly localized and on a very small scale. Potential sources of geothermal energy are widespread, as evidenced by the present and former volcanic activity on the Aleutian Islands, the Alaska Peninsula, the Wrangell Mountains, and elsewhere in the State (fig. 5). The Aleutian volcanic arc geothermal sources may be significant to fishing industries, whereas those sources closer to transportation routes or population centers, such as the Wrangell Mountains, may provide power that can be transmitted to other parts of the State.

Federal funding and activity in geothermal resources is currently low. The Department of Energy contracted for two geothermal studies in Alaska, briefly described below. While the U.S. Geological Survey continues studies of volcanoes in Alaska, the emphasis of this work is not centered on their energy potential.

The Department of Energy provided funds for studies of geothermal characteristics and of the origin of gases and saline water at mud volcanoes in the Copper River Basin (fig. 5). Scientists from the University of Alaska Geophysical Institute gathered the data and performed geochemical analyses that indicate that a magma body intruded limestone bedrock as much as 2,000 meters below the Klawasi mud volcanoes, the interaction being responsible for the carbon dioxide gas and bicarbonate in the saline water there. Methane- and nitrogen-rich gases at the nearby Tolsona volcanoes suggest a different chemical environment for magma-limestone reactions.

The Alaska Division of Geological and Geophysical Surveys (ADGGS) and the University of Alaska, with funding by the Department of Energy, started an investigation of the geothermal potential of the Mount Spurr area on the west side of Cook Inlet (fig. 5). Petrologic studies are being done by the ADGGS, and other radiometric, geological, geophysical, and geochemical studies are being carried on by University scientists. Initial results of this work indicate the presence of a

shallow magma chamber and warm springs whose waters are derived from diverse sources. Targets for further study have been delineated (Wescott and others, 1985).

The ADGGS completed reports about two prospective geothermal energy sources: Akutan Island and the Makushin geothermal area of Unalaska Island (fig. 5). For Akutan, data indicate a warm water reservoir (120–135 °C) at about 150 meters below the surface of the lower end of a valley about 6 kilometers west of the village of Akutan. The energy available from this source appears to be more than sufficient for local heating and electrical power needs. Two technical reports published prior to 1985 concerning the Makushin area conclude that the deep hot-water source here resides above a shallow magma chamber. Further, in the recent past, the reservoir was perhaps 50–100 °C warmer and was hot-water dominated, not steam dominated as it is now. The energy source here is more than adequate for local needs. These studies were partly funded by the Department of Energy as well.

In November 1985 a second geothermal lease sale was proposed for the Mount Spurr area. The Alaska Department of Natural Resources Division of Oil and Gas issued a request for public comments and applications for about 2,640 acres. If sufficient interest is expressed, tracts for which multiple applications are received will be offered for competitive sale; tracts for which single applications are received may be issued geothermal prospecting permits. In a geothermal lease sale on June 24, 1986, both offered tracts, totalling 2,628 acres, were awarded. The State earned nearly $13,000 in the sale. The previous sale, in 1983, attracted one bid for 640 acres.

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NONFUEL MINERALS

The depressed condition of the domestic mining industry continued to adversely affect exploration, development, and production of nonfuel minerals in Alaska in 1985. Worldwide, metals experienced another year of low prices, some of which dropped below the already low values of the past several years. For example, gold was down as much as 20 percent from 1984, silver was down 33 percent, and lead and zinc were down 19 and 14 percent, respectively (Alaska Journal of Commerce and Pacific Rim Reporter, July 15, 1985).

Some people attribute the general economic situation of mining to the strength of the U.S. dollar. In an article about the mineral industry in the Fairbanks Daily News-Miner (June 20, 1985), John Sims, then director of Alaska's Office of Mineral Development, saw the major domestic mining companies having extremely difficult times, causing many mines to close, while mines in places such as Chile and central Africa are in full production. The effect of this competition is shown in some changes in minerals companies in Alaska. Anaconda Minerals Company, a very active investor in mineral exploration in Alaska during the past several years, was dissolved during 1985 and sold by the parent company, Atlantic Richfield Company (ARCO). Similarly, Phillips Petroleum Company, established 30 years ago in Alaska, closed its Anchorage exploration office in July and transferred its Alaska headquarters to Kenai. Nerco Minerals, Inc., laid off 15 employees from its Fairbanks headquarters as a result of reorganization and continued depressed gold and silver prices.

According to State of Alaska records, the number of new mining claims filed in Alaska during the first quarter of 1985 was less than half that filed during the first quarter of 1984. This represented the lowest number of claims filed during this period for the past 6 years. The low level of activity, due in part to the depressed worldwide mineral prices, may also reflect environmental protection regulations, such as water-quality standards, and the lack of transportation facilities to known mineral deposits.

Data obtained by the State of Alaska indicate that statewide mineral production totaled about $226 million in 1985 (table 3). This represents a modest increase over the 1984 total. The increase is due principally to increased coal production for the export market, increased placer gold production (despite lower prices), and increased sand and gravel production in the Fairbanks and Prudhoe Bay areas (Alaska Construction and Oil, 1986; Bundtzen and others, 1986). Exploration expenditures dropped again in 1985 and were nearly 60

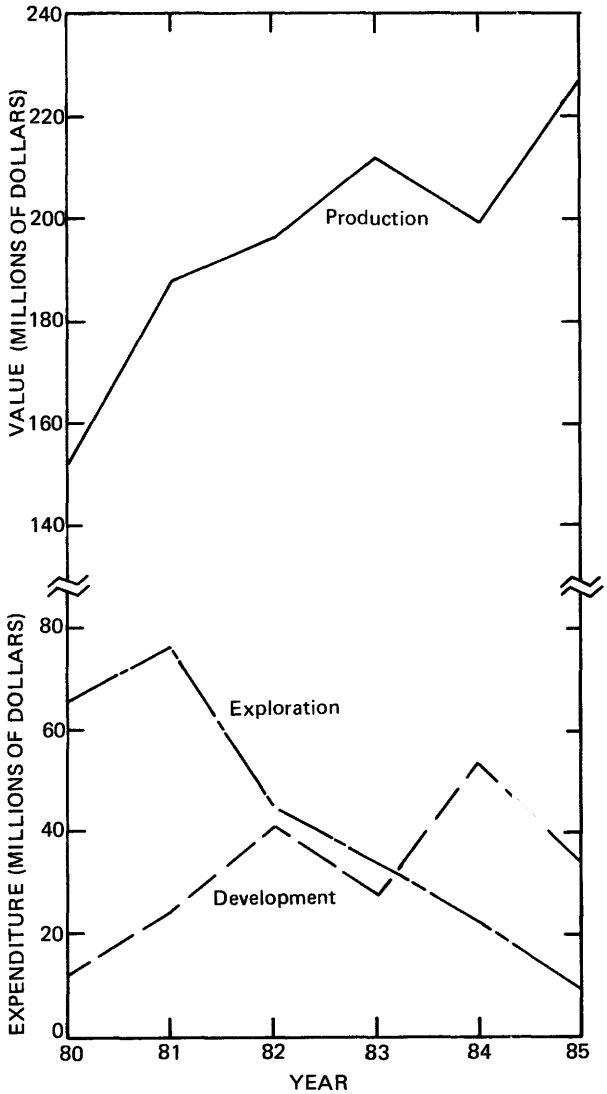
TABLE 3.—*Mineral production in Alaska, 1984–85.* [Assumed average prices: gold, $325/oz; silver, $6/oz; antimony, $1.50/lb; coal FOB Healy, $29/ton; peat $6.50/cubic yd; sand and gravel $3.99/ton, varying with location (Bundtzen and others, 1986)]

	Volume		Value ($ x 1000)	
	1984	1985	1984	1985
Metals				
Gold (oz)	175,000	190,000	63,000	61,175
Mercury (lb)	380	2,094	1.5	10
Antimony (lb)	135,000	65,000	225.7	98
Silver (oz)	20,000	28,500	159	171
Tin (lb, metal)	225,000	300,000	400	650
Industrial minerals, coal, and peat				
Sand and gravel (million short tons)	27.0	28.2	95,000	112,062.7
Building stone (million short tons)	2.7	2.5	16,000	12,150
Jade, soapstone (tons)	5.5	---	16.5	---
Coal (short tons)	849,161	1,370,000	23,775	39,730
Peat (cubic yd)	125,000	85,000	859.3	552.5
Total			199,437.1	226,439.2

percent less than in the previous year (fig. 6). Development expenditures also decreased, but, according to Bundtzen and others (1986), this total may be deceptive because 1984 saw record spending, primarily for the Seward coal loading facility.

In spite of low metal prices, some see a bright future for Alaska's mining. Ed Eboch of the Alaska Department of Labor has said the potential for mineral, coal, and industrial mining in Alaska in the next decade is excellent. Eboch predicts that by the mid–1990's demand for minerals should increase because many developing countries will be needing coal for energy production and sand and gravel and other minerals for construction or industries (Anchorage Daily News, July 11, 1985). If metal prices improve, three major mines in Alaska could go into production and put about 1,500 people to work. The three potential mines are: the Red Dog lead, zinc, and silver deposit north of Kotzebue; the Greens Creek silver, gold, zinc, and lead occurrence near Juneau; and the Quartz Hill molybdenum property near Ketchikan. These and other areas discussed in the following pages are shown on figure 7 and listed in table 4 .

Red Dog is the world's largest undeveloped zinc-lead-silver deposit, having reserves of 85 million tons and a projected mine life of 50 years. (See previous annual reports in this series.) The deposit moved closer to production in 1985 as a result of legislation passed by the Federal Government that provides for a land exchange between NANA Regional Corporation and the Department of the Interior. The land swap permits construction of a 57–mile haul road from a port facility to the mine site. The Alaska Legislature has made it possible for the Alaska Industrial Development Authority (AIDA) to finance as much as $175 million of mine-related construction and a port; a March 1986 agreement allows port construction to begin in 1986, and road and mine construction will start in the next 2 years. A shallow-water



(Data from Alaska Division of Geological and Geophysical Surveys, 1983, 1985, 1986)

FIGURE 6.—Minerals exploration and development expenditure and production value, 1980–85.

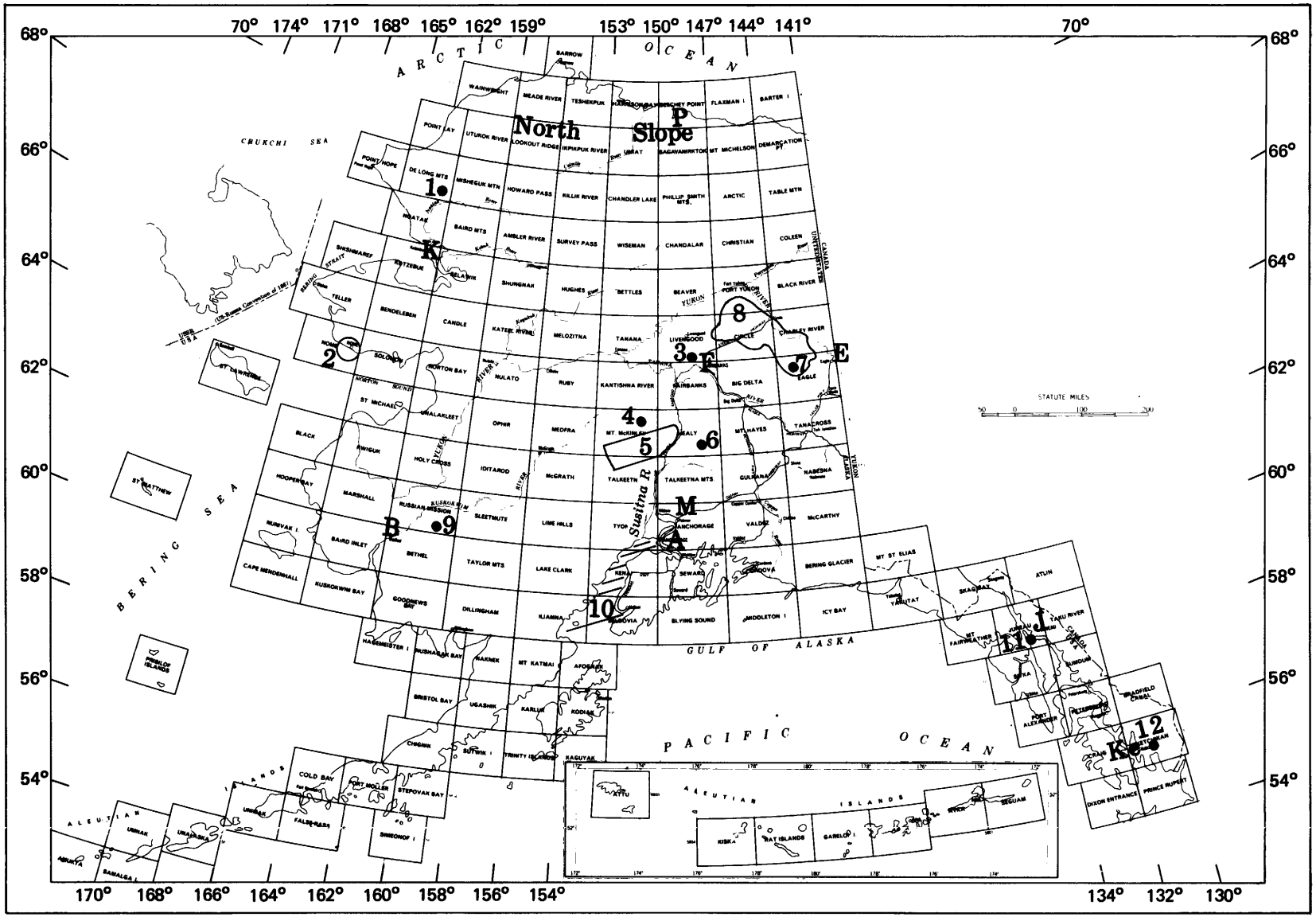


FIGURE 7.—Areas of important industry activity for nonfuel minerals.

dock and staging area are being built in 1986. Repayment negotiations between AIDA and Cominco Alaska, the company that will mine the deposit, may require a 3–year road construction schedule rather than 2 years. This would delay startup of mining from 1989 to 1990 (Alaska Economic Report, Sept. 21, 1985). The timing for the development of Red Dog is thought to be favorable. Some mineral economists feel that the end of the current decade would be the ideal time to bring a new zinc mine on line as mines elsewhere run out of ore (Alaska Journal of Commerce and Pacific Rim Reporter, Oct. 21, 1985). The economic potential of the proposed mine is also the basis for a request by a Native group to form a new borough; the mine would be the tax base and a major employer for that borough. Voters approved creation of the borough in a May 1986 election.

The U.S. Borax and Chemical Company's Quartz Hill molybdenum mine project near Ketchikan is one of Alaska's largest mineral deposits—1.5 billion tons of material having a grade of 0.136 percent molybdenite, about 20 percent of that being easily accessible. Located as an inlier in the Misty Fiords National Monument, the Quartz Hill property has managed to survive as a potential mine despite a highly restrictive land status. Mining is projected to begin in the early to mid–1990's, when molybdenum prices are expected to increase. The Final Environmental Impact Statement (EIS) for the project is to be submitted in 1986, and mine construction should take about 4 years. Three major decisions remain ahead for the project: (1) location of tailings disposal—the mine is expected to generate about 80,000 tons of ore per day for 55 years, (2) a source of mine makeup water, and (3) a power source (Alaska Economic Report, July 10, 1985).

The Noranda Mining, Inc., Greens Creek project is a lead-zinc-copper-gold-silver deposit on Admiralty Island in southeast Alaska. Exploration drilling continued in 1985, but the permit to explore expired in December 1985. However, the President signed legislation to extend exploration for one more year. Road construction is planned to begin in 1986, and underground development in 1989. The EIS was completed in 1982, and the mine plan has been approved by the U.S. Forest Service. The deposit, except for being in the Admiralty Island National Monument, is relatively free of serious environmental issues (Alaska Economic Report, July 10, 1985). Published reserves are 1,457,000 tons grading 9.31 percent zinc, 3.37 percent lead, 0.45 percent copper, and 17.58 ounces of silver and 0.14 ounces of gold per ton. Discovery by Noranda of a new north ore zone in 1984 would increase reserves to 10 million tons (Northern Miner, April 25, 1985).

TABLE 4.—*Selected areas of industrial nonfuel mineral activity mentioned in the text* [See fig. 7]

Area number or letter	Activity
1.	Red Dog zinc-lead-silver prospect
2.	Nome area, gold placers
3.	Grant gold mine, Fairbanks district
4.	Kantishna Hills
5.	Denali National Park
6.	Valdez Creek gold mine
7.	Asbestos prospect
8.	Circle Mining District
9.	Tuluksak River placer gold operation
10.	Cook Inlet submarine placer gold prospect
11.	Greens Creek zinc-lead-copper-silver-gold prospect
12.	Quartz Hill molybdenum deposit
A Anchorage	K Kotzebue
B Bethel	Ke Ketchikan
E Eagle	J Juneau
F Fairbanks	P Prudhoe Bay area
M Matanuska Valley	

Total reported Alaskan 1985 gold production was 190,000 ounces, nearly a 9 percent increase from 1984. The Circle Mining District northeast of Fairbanks remained the largest producer of gold. However, Valdez Creek produced about 30,000 ounces in 1985, a sizeable percentage of the State total. Drilling at Valdez Creek has identified buried channels indicating several more years of production (Alaska Construction and Oil, 1986). (See fig. 7 for locations.)

Although the total production from gold placer mines increased, the number of active mines decreased slightly in 1985. The decrease in activity was partly a result of lower gold prices, but was also due to water-quality standards. The Alaska Department of Environmental Conservation imposed water-quality standards on mining that are more stringent than those of the Federal Environmental Protection Agency. The Miners Advocacy

Council (MAC) filed a lawsuit charging that the State did not hold the required public hearings when adopting the standards. The MAC feels that the standards are virtually impossible to comply with and, if enforced, would shut down nearly every placer mining operation in Alaska (Fairbanks Daily News-Miner, May 7, 1985). Two environmental groups in the State have added their arguments to the litigation. Trustees for Alaska and Northern Alaska Environmental Center feel that the State has not gone far enough to protect water quality in Alaska, arguing that the new State standards on settleable solids and turbidity should not pose great difficulty for the miners (Anchorage Times, May 23, 1985).

Additionally, the seventh annual Conference on Alaska Placer Mining held in Fairbanks in March 1985 was largely concerned with the State water pollution laws for placer miners. It was generally agreed that the technology needed to comply with the State turbidity regulations (that water coming from mines be no more than 5 turbidity units dirtier than natural stream water) does not exist. Miners claimed that water discharged from even the cleanest mines is several thousand units dirtier than the upstream or original water (Anchorage Times, March 29, 1985).

A State program was created in July 1984 to provide funds for research in innovative placer mining methods, with goals of decreasing environmental damage from placer mining, reducing water pollution, and improving fine gold recovery. The Departments of Natural Resources and Environmental Conservation distributed grants totalling $2.7 million to 30 miners in 1985. Those methods that proposed a reduction in water use through recycling received special consideration (Alaska Journal of Commerce and Pacific Rim Reporter, April 22, 1985).

In related actions, mining operations in seven national parks and preserves in Alaska were ordered closed by a July 22, 1985, Federal District Court order until the Park Service completes full environmental studies of the effects of mining operations in the parks. (See fig. 1 for park locations.) The mandatory shutdown date was extended from September 5, 1985, to October 15, 1985, allowing a complete season of mining. Substantial environmental damage by mining was found to have occurred in some parks. About 40 mines that operate in the parks and several hundred claim-holders are affected by this action. Under this court decision, the mines would not be allowed to operate in the 1986 season, and the claim-holders would not be permitted to do their annual assessment work (Anchorage Daily News, July 24, 1985; Anchorage Times, Dec. 10, 1985). The ruling was in appeal in March 1986. In February 1986 Native and environmental groups sought to have stricter review and enforcement of mining regulations by the Bureau of Land Management and to have mining cease on Federal land until the effects of mining are evaluated. The Alaska Miners Association, opposing the suit, sought to have the State enter the case with them, but was turned down.

Mining for gold in coastal areas is part of Alaska's history and may well increase. At Nome (fig. 7), an offshore dredging operation recently began producing test runs of placer gravel. Inspiration Mines, Inc., is using a 5–cubic-yard clamshell bucket mounted on a 180–foot barge to mine the underwater gravels about 1,000 feet from the shoreline (Alaska Construction and Oil, 1986). However, Aspen Exploration Corporation was denied a permit to dredge offshore acreage in upper and lower Cook Inlet in a search for gold, silver, nickel, and other minerals. The company had applied for the permits in 1980 and spent 5 years and $1 million working with State agencies so the permits could be issued. The Alaska Department of Natural Resources denied the permit request because of the potential impact to the fishery resources. The dredging would have occurred in one of the State's most popular and productive fishing grounds.

For Denali National Park and Preserve, the Alaska Land Use Council, an appointed body of State and Federal officials, has recommended to Congress that mining for gold, silver, antimony, and other minerals be substantially increased. They have asked Congress to open 103,435 acres in the Kantishna Hills area (fig. 7) to mining. Congress is expected to act on this proposal in 1986 (Anchorage Times, Dec. 16, 1985). Meanwhile, approximately 320,000 acres in the Susitna River (fig. 7) watershed were closed to mineral entry by the State Department of Natural Resources. The need for retaining State lands for recreation near urban areas prompted the action. However, existing gold placer mining operations will have grandfather rights under the new regulations (Anchorage Times, Aug. 20, 1985).

What was expected to become a model for future gold mines in the area, the Grant gold mine near Fairbanks (fig. 7) began production in November 1985. The mine was built to process as much as 230 tons of ore per day, and its production cost was expected to be $175 per ounce. Reserves are estimated at 591,000 tons of ore averaging 0.61 ounces of gold per ton (Petroleum Information, Alaska Report, Dec. 4, 1985). One quartz vein at the mine was expected to supply ore for about 16 years, and there are at least 12 other gold-bearing veins in the Grant mine area (Fairbanks Daily News-Miner, Nov. 6, 1985). Gold recovery rose from 0.2 ounces per ton in October 1985 to about 0.5 ounces per ton in early December 1985 (Fairbanks Daily News-Miner, Jan. 3, 1986). However, after only two months the mine shut down (Fairbanks Daily News-Miner, Jan. 2, 1986), and a major partner withdrew.

A plan for gold mining on the Tuluksak River in southwestern Alaska (fig. 7) was approved by Department of the Interior Board of Land Appeals in August 1985. The project involves dredging a channel through the floodplain of the Tuluksak River. The mining of the floodplain deposits had been challenged by the village of Tuluksak, the city of Bethel, and fishermen in the area who felt that mining could disrupt the fishing industry and harm the environment.

Echo Bay Mining, a Canadian company, announced plans to reopen the Alaska-Juneau gold mine near Juneau (fig. 7), which produced more than 2.8 million ounces of gold earlier in this century.

Sand and gravel continued to be economically important, accounting for more than half of the value of minerals produced in 1985. The majority of this material was used for petroleum development on the North Slope. A lull in the housing market and road construction has reduced the need for gravel near major urban areas. An article in the Alaska Journal of Commerce and Pacific Rim Reporter for the week of May 13, 1985, notes that an average of 38,280 tons of gravel were moved by train from the Matanuska Valley to Anchorage daily. Reserves in this area are thought to be adequate for the next few years.

Doyon Ltd.'s asbestos prospect near Eagle (fig. 7) is not now scheduled for development because of current market conditions and health concerns.

A court decision in late 1985 claimed that the Interior Department unlawfully reclassified 170 million acres of previously protected Federal land throughout the United States. The ruling could halt oil and gas exploration, homesite programs, mining, and other activities on at least 11 million acres of Alaska lands. The decision, which followed a lawsuit by the National Wildlife Federation, prohibits staking of additional mining claims, obtaining new leases, mining, timber removal, land clearing, construction, or other types of development. The precise impact of the ruling is uncertain; clarification of the court decision is being asked by the Bureau of Land Management (Anchorage Daily News, Dec. 10, 1985).

The State of Alaska Office of Mineral Development, Division of Mining, and Division of Geological and Geophysical Surveys (ADGGS) continue to publish an annual summary of information about Alaska's mineral industry. Their Special Report 38 for 1984 (Eakins and others, 1985) is the fourth in the series; the fifth was published in June 1986. (Bundtzen and others, 1986). Those reports are useful complements to this report, emphasizing industrial activity.

ACTIVITY BY FEDERAL AGENCIES

U.S. Geological Survey

Studies of nonfuel minerals in Alaska are an important part of the U.S. Geological Survey's program in Alaska. The Alaska Mineral Resource Assessment Program (AMRAP) continues as a prominent effort of the Survey in its goal of mapping and assessing the mineral potential of Alaskan lands. The activities of this program were carried on at a level commensurate to that of the past few years. The Trans-Alaska Crustal Transect (TACT) project (fig. 8) is well under way, and a major portion of the data has been gathered for the southern part of the transect. Work on the Wilderness Study program and the National Petroleum Reserve in Alaska (NPRA) (fig. 3) is essentially complete.

AMRAP studies are conducted at four progressively more detailed levels to produce comprehensive assessments of Alaska's mineral and energy resources. Level I studies are statewide in scope; their products are generally at a scale of 1:2,500,000. In 1985 work continued on maintaining and updating the mineral data base for the entire State. Level II of AMRAP looks at large regions of the State; resulting maps are at a scale

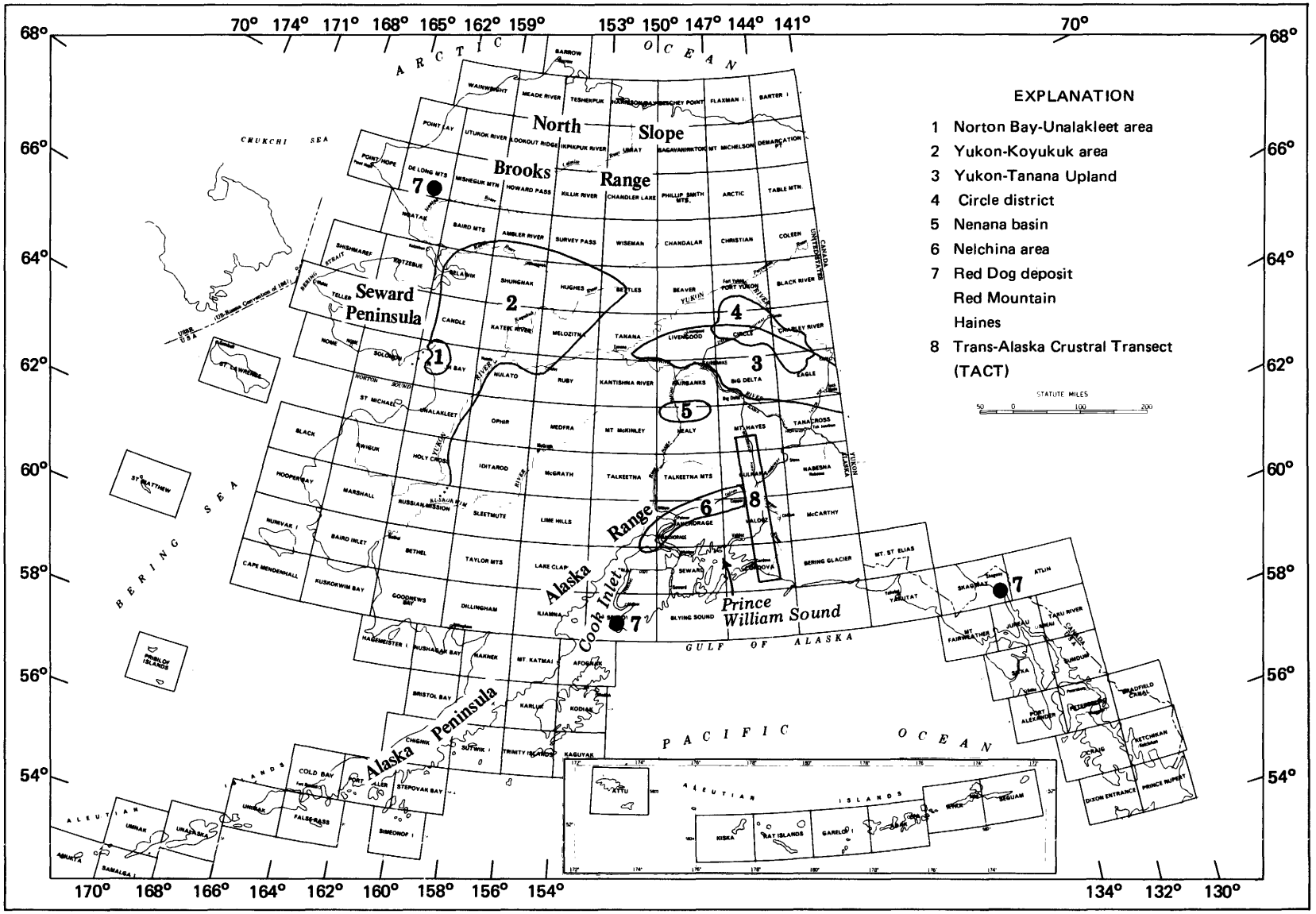


FIGURE 8.—Location of selected U.S. Geological Survey project study areas.

of about 1:1,000,000. Work continued on the metallogenesis of the eastern Alaska Range, and a Level II study is planned for the Alaska Peninsula, to begin in 1986.

Level III currently receives the major effort of AMRAP. It consists of multidisciplinary evaluations involving team studies of selected $1° \times 3°$ quadrangles. Geologic, geochemical, and geophysical data are gathered to produce an inventory of areas having mineral resource potential. Studies are currently progressing in 22 quadrangles. In 1985 Level III studies were begun in the Lime Hills quadrangle in southwest Alaska and in the Livengood quadrangle in central Alaska, but not all of these are active projects in 1986. AMRAP fieldwork continued in the Juneau, Taku River, Craig, and Dixon Entrance quadrangles in southeastern Alaska; the Port Moller, Stepovak Bay, Mount Katmai, and Naknek quadrangles on the Alaska Peninsula; the Baird Mountains, Killik River and Chandler Lake quadrangles in the Brooks Range; and the Gulkana quadrangle in central Alaska. The Iditarod quadrangle AMRAP, also in central Alaska, is a joint effort of the U.S. Geological Survey and the Alaska Division of Geological and Geophysical Surveys. Reports are being prepared and are in review for the following quadrangles for which fieldwork is complete: Ugashik and Karluk on the Alaska Peninsula; Anchorage, Healy, and Mount Hayes in southcentral Alaska; Solomon and Bendeleben on the Seward Peninsula; Wiseman in the Brooks Range; and Petersburg in southeastern Alaska. Figure 9 shows the current status of AMRAP Level III studies.

Level IV of AMRAP consists of detailed studies (at a scale of 1:63,360 or larger) of mineral districts, specific deposits, or related topics. The general locations of current Level IV studies are shown in figure 8, and the project titles are listed in table 5. Among the Level IV work begun in 1985 are studies of sand and gravel resources of the eastern Arctic Coastal Plain, a Northwest Alaska Mineral Assessment, and investigations of ash-flow tuffs of the Pavlof Islands.

Some of the products of AMRAP released in 1985 are reports in the Survey's Miscellaneous Field Studies series about onshore energy resources of the Chignik-Sutwik quadrangles (Detterman and others, 1984 [1985]), and mineral resource and geochemical maps for the Lake Clark (King and others, 1985) and Philip Smith Mountains (Menzie and others, 1985) quadrangles. Open-file reports published in 1985 cover geochemical data for the Solomon and Bendeleben quadrangles (Arbogast and others, 1985) and the Mount Hayes quadrangle (Zehner and others, 1985), as well as geologic maps of the Atlin, Juneau, Taku River, and Skagway quadrangles (Brew and Ford, 1985). An annotated bibliography for the Baird Mountains quadrangle by Karl and others (1985) was also released. A list of report products of AMRAP through January 1, 1986, is presented in U.S. Geological Survey Circular 978 (Bartsch-Winkler and Reed, 1986). Selected 1985 AMRAP-related releases are listed at the end of this section and the back of this report; about 40 reports were generated by the program in 1985.

A public meeting on the subject of the Solomon-Bendeleben AMRAP project was held on March 19, 1985, in Anchorage. The meeting was attended by personnel from private mining companies, State and Federal government agencies, and private citizens with an interest in the region. The discussion at this meeting indicated particular interest in the gold-quartz veins on the Seward Peninsula.

In addition to the mineral resource assessment studies, geologic mapping is ongoing at 1:250,000 scale in several areas of the State. Geologic maps of the northern and central parts of the Unalakleet quadrangle (Patton and Moll, 1985) and of the Ophir quadrangle (Chapman and others, 1985) were published.

The second year of work on the Trans-Alaskan Crustal Transect (TACT) program proceeded on schedule. This is a multidisciplinary study of the geology, potential field geophysics, deep seismic refraction and reflection of the Alaskan crust along the Trans-Alaskan Pipeline System route. As a result of work during the 1984 and 1985 seasons, fieldwork for a bedrock strip map at a scale of 1:63,360 is complete for the southern one-third of the State, from the mouth of the Copper River on Prince William Sound to the Denali fault in the Alaska Range. The map will have a minimum width of a 15–minute quadrangle and extends to several quadrangles width in critical areas along major geologic sutures such as the Contact and Border Ranges faults, the Broxson Gulch thrust, and the Denali fault, which lie within or north of the area shown for TACT on figure 8. This map will be used as a basis for interpreting the deep seismic refraction, gravity, and

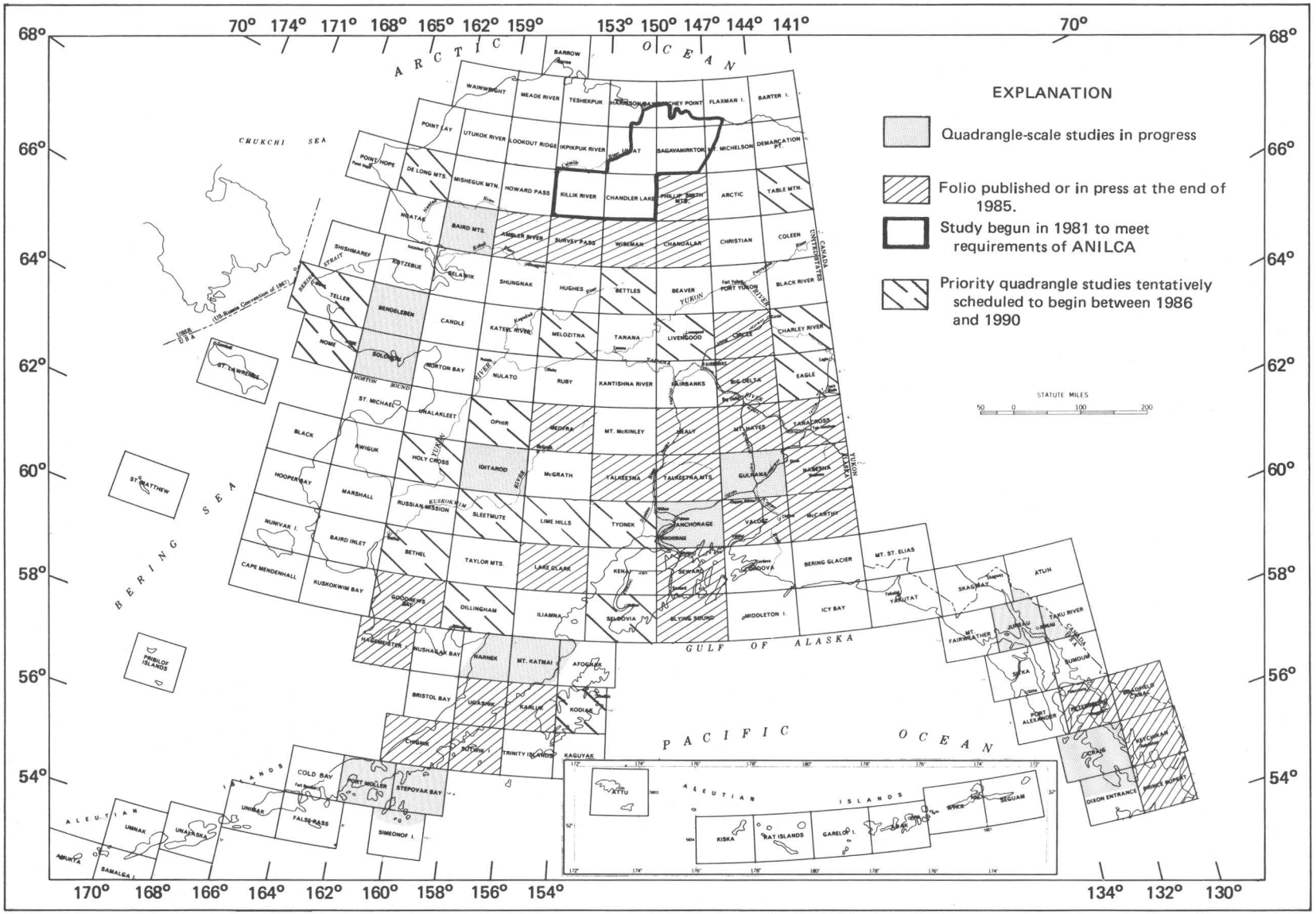


FIGURE 9.—Status of Level III Alaska Mineral Resources Assessment Program studies, January 1, 1986.

TABLE 5.—*Level IV studies of the Alaska Mineral Resource Assessment Program active in 1985; figure 8 shows generalized areas under study. Projects marked by an asterisk are of statewide scope.* [Modified from Bartsch-Winkler and Reed, 1986]

Areal mineral resource assessments

*Tin commodity studies
*Placer gold deposit studies
*Subjective probability estimations of Alaskan mineral resources
Mineral deposits, western Brooks Range
Metallogenesis, eastern Alaska Range
Mineral resources, interior Alaska
Geology and mineral resources, Yukon-Tanana Upland
Geology and mineral resources data summary, southwestern Alaska
Geology and mineral resources, Norton Bay-Unalakleet region
Tin and tungsten deposits, Circle district

Areal energy resource assessments

Oil and gas potential of interior basins
*Geochemistry of sedimentary organic matter, crude oil, and natural gas in Alaska
Stratigraphy and depositional history of Jurassic and Cretaceous sequences, North Slope
Reservoir characteristics of the Lisburne Group, arctic Alaska
Coal resources of northern Alaska
Coal studies in the Nenana basin
Uranium potential of Alaskan basins

Exploration geophysical studies

Gravity studies (including Red Dog, Haines, and Red Mountain deposits)
Geophysics and Yukon-Koyukuk basin and its border lands
Mining geophysics of central Alaska

Biostratigraphic studies

Brooks Range and Arctic Slope studies
*Paleozoic and Mesozoic radiolarians
*Brachiopod and conodont paleogeography
Cenozoic molluscan biostratigraphy, southern Alaska
Mesozoic dinoflagellate biostratigraphy, southern Alaska

Framework or process studies

Yukon-Koyukuk crustal transect study
Structural analysis of interior metamorphic terranes
Mafic and ultramafic rocks of interior Alaska
Coastal sediments of upper Cook Inlet
Mesozoic stratigraphy of the Alaska Peninsula
Upper Cook Inlet-Nelchina area stratigraphic studies
*Paleomagnetism of accreted terranes
*Metamorphic facies map of Alaska

Exploration geochemical studies

Gold amalgamation studies in streams
Evaluation of Department of Energy National Uranium Resource Evaluation studies

Isotopic and radiometric studies

*K-Ar studies and radiometric age file
Zircon geochronology, interior Alaska
Lead, oxygen isotope studies (Brooks and Alaska Ranges, Alaska Peninsula, Seward Peninsula, Prince William Sound)
Geochemical characterization of accreted igneous arcs, southern Alaska

magnetic data that are now complete for southern Alaska along the TACT route, and for the forthcoming deep seismic reflection studies that will be conducted for approximately 200 kilometers of the TACT route in southern Alaska in 1986. TACT seismic refraction lines have been surveyed and interpreted for the southern part of Alaska; also completed are detailed gravity and magnetic surveys of the area. Several short descriptions of TACT seismic study results that provide preliminary definition of deep structures in the area are given in Bartsch-Winkler and Reed (1986) and Bartsch-Winkler (1985).

Several papers about current research pertaining to mineral resources in Alaska were presented at the first McKelvey Forum in February 1985 in Denver, Colo., entitled "USGS Research on Mineral Resources—1985" (Krafft, 1985). A summary of AMRAP work to 1985 was presented as a poster session at this gathering. This forum was established to improve communication between the U.S. Geological Survey and the earth science community. The forum will be an annual event, and its subject matter will alternate between mineral and energy resources.

Two circulars published in 1985 (Bartsch-Winkler and Reed, 1985; Bartsch-Winkler, 1985) present a broad selection of short papers about mineral resources (for example, Jones and others, *in* Bartsch-Winkler and Reed, 1985), as well as other topics currently under study by the Survey. The results of selected geologic studies in 1985 are described in Circular 978 (Bartsch-Winkler and Reed, 1986).

Bureau of Mines

The Bureau of Mines Alaska Field Operations Center (AFOC) conducts programs under four designated responsibility areas in the directorate of Mineral Data Analysis and coordinates work with Bureau research centers throughout the United States. Such activities in Alaska are summarized in the following paragraphs.

The Minerals Availability program (MAS) is described in the introductory pages of this report. In 1985, data for 552 Alaskan properties were entered in its Mineral Industry Location System (MILS, a subset of MAS) file as potential mineral producers. Publication of a MILS directory for Alaska, which gives names and locations of 281 deposits and detailed information for 67 significant deposits, is planned for 1986. MAS activities also included a study to predict remaining reserves of past Alaska lode precious metal producers. In addition, a study of the application of current Bureau methodologies for estimating undiscovered resources to accomplish MAS objectives was completed.

The Policy Analysis program has focused attention on land ownership categories on Federal and State land. These data have been plotted on maps at 1:500,000 or larger scale, thereby providing a visual determination of land available for mineral exploration and development in the State. Roberts (1985) presents land availability informatio for southeastern Alaska, and work on maps for north- and south-central Alaska is nearing completion. Study of northern Alaska will commence in 1986. However, because of the dynamic nature of land status, these maps present information that is valid only for a limited time frame.

Reports written under the aegis of the State Mineral Officer include the Alaska chapter in the "Minerals Yearbook, Volume II" and the annual preliminary "Mineral Industry Survey," which details significant mineral activity throughout the State in the preceding year. Periodic updates have been prepared for the "Alaska Mineral Briefing Profile," as have listings of associations and organizations interested in minerals and of meetings, conferences, and symposia of the mineral industry. The State Mineral Officer continues to participate with the interagency team preparing the EIS for the Quartz Hill molybdenum mine development project.

Mineral Land Assessment (MLA) work completed in 1985 included publication of reports about mineral resources in the Juneau and Kantishna Mining Districts, Chugach National Forest, and Seward Peninsula area and a report summarizing gallium and germanium potential in Alaska.

The Bureau's fieldwork in the Juneau Mining District (locality 8, fig. 10) is part of a 4-year mining district study. This program will identify the type, amount, and distribution of mineral deposits in the district, determine ore reserves, study beneficiation technologies for the ore, make feasibility studies, and address economic and legislative effects on mineral development. The Juneau study is a cooperative study involving the Bureau of Mines and the Alaska Division of Geological and Geophysical Surveys (ADGGS). ADGGS personnel will make detailed geologic studies of selected areas, while Bureau personnel conduct site-specific examinations. The Juneau studies are on or ahead of schedule in most areas. To promote efficient evaluation of the district, field responsibilities have been subdivided into three areas: the Porcupine Mining, Juneau Gold Belt, and Glacier Bay/Mount Fairweather areas.

In the Porcupine mining area, 25 lode deposits and occurrences and nine formerly producing gold placer streams were examined, and 736 samples were collected. Highlights of this work include the rediscovery of a high-grade silver deposit, definition of a zone of gold mineralization that has potential for containing a large-tonnage, low-grade gold deposit, and identification of 8 million–9 million cubic yards of placer resources having subeconomic to marginal grades at 1985 gold prices. In the Juneau Gold Belt, 85 mines, prospects, and occurrences were examined, and 700 samples were collected in 1985. Accomplishments included the discovery of a molybdenum occurrence near Mount Ogden, detailed mapping of the Alaska-Juneau mine lode system, and definition of two areas with volcanogenic massive sulfide mineral potential. A total of 100 samples were collected, and three deposits were mapped in the Glacier Bay/Mount Fairweather area. Accomplishments in this area included collection of 2,000 feet of site-specific geophysical survey data, discovery of arsenopyrite-bearing veins near the margin of the Marjorie pluton, identification of anomalous placer gold in a drainage adjacent to the Orange Point deposit, and the location of areas favorable

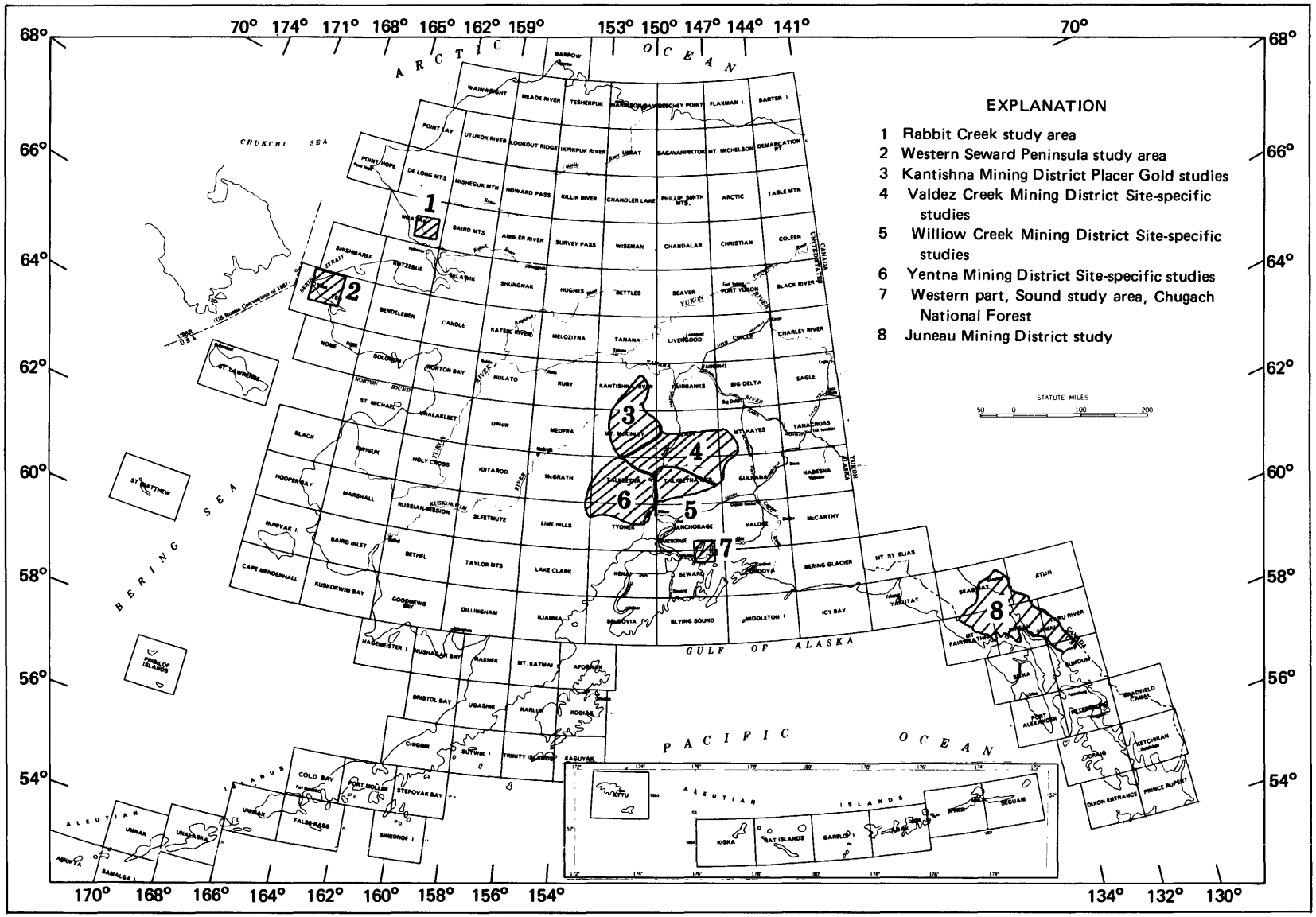


FIGURE 10.—Location of Bureau of Mines 1985 study areas.

for mineralization along the north and west margins of the Mount Fairweather ultramafic pluton.

In 1985 the Bureau conducted sizing studies of gravel and gold samples collected in 1983 from Spruce, Glen, Eureka, Moose, and Eldorado Creeks in the Kantishna Mining District (loc. 3, fig. 10). More than 99 percent of the gold in these samples ranges in maximum dimension from 3.36 to 0.21 millimeters (from −6 to +70 mesh). These kinds of data are used in designing recovery plants and settling ponds. Results of the study are described in Fechner and Hoekzema (1986).

Fieldwork for the Chugach National Forest Roadless Area Resource Evaluation II study was completed in 1982. The study area includes locality 7 of figure 10 and land to the east. Bureau of Mines site-specific sampling studies in the north-central part of the area are described in Meyer and Fechner (1985).

Studies of the Seward Peninsula (loc. 2, fig. 10) have resulted in a report by Mowatt and Jansons (1985a) that describes chemical and petrographic studies of selected tin-bearing rocks of contact-metasomatic origin in the Cassiterite Creek and Brooks Mountain areas of the Seward Peninsula. Tin content of these rocks ranges from 0.39 to 8.9 percent, although cassiterite, a primary tin ore, was not observed in the samples.

Bureau reports (Fechner, 1986; Kurtak, 1986) summarize investigations of lode and placer deposits in the Yentna and Willow Creek Mining Districts (fig. 10). Two potentially significant deposits were identified in the Yentna District: An unreported mineral occurrence in the Talkneetna Mountains containing from 5 to 10 percent zinc and as much as 6 ounces of silver per ton, and samples from an outcrop of banded quartz-hematite-pyrite-chalcopyrite in the Talkeetna Mountains containing 6 percent copper. Three significant mineralized areas in the Valdez Creek Mining District were delineated, primarily from a literature search: the Chulitna River-Broad Pass area, the Clearwater Mountains area, and the Maclaren River and Glacier area. A report concerning site-specific studies in the Valdez Creek Mining District is nearing completion.

Two additional Bureau reports released in 1985 discuss other mineral resources. Fechner (1985) suggests than the most likely sources of gallium and germanium (used in high-technology industries) in Alaska are large massive sulfide and coal deposits but that additional sampling is needed. A report about platinum and palladium in mafic and ultramafic rocks in the Noatak quadrangle (Rabbit Creek area, fig. 11) in the western Brooks Range (Mowatt and Jansons, 1985b) summarizes the results of preliminary chemical and petrographic studies. Platinum concentrations ranging from 412 to 1,406 parts per billion (ppb) and palladium concentrations of from 343 to 892 ppb were present in five of eight float samples analyzed; copper content ranges from 0.1 to 0.3 percent. Geologic relations suggest that similar rocks in the area should be considered as prospective for these elements. The most significant known platinum-group metal reserves are in river placers near Goodnews Bay (fig. 11) in southwestern Alaska; in 1985 the Bureau continued evaluation of nearby lode and marine placer occurrences. Copper-nickel deposits in the east-central Alaska Range were also found to contain minor amounts of platinum-group metals and cobalt; beneficiation studies are under way. To facilitate field evaluations of platinum-group-metal occurrences, Barker and others (1985) made a statistical study of the sampling variance for certain platinum-palladium deposits.

As part of the MLA studies mandated by ANILCA, the Bureau is evaluating occurrences of critical and strategic minerals. Project work in 1985 was divided between studies of tin-tantalum-columbium and chromium-cobalt-platinum-group metals. Warner (1985) summarizes available data on tin, tantalum, and columbium in Alaska. At least six geologic terranes favorable for tin and columbium and a region in southeast Alaska containing columbium and rare-earth minerals have been identified. Several prospects were studied in 1985 (fig. 11). Investigations and sampling for metallurgical testing of lode tin were carried on in the Chulitna area, Circle district (Burton and others, 1985), Kougarok, Kanuti region (including the Sithylemenkat deposit), and Fort Hamlin Hills. Distribution of placer tin was mapped at Tozimoran Creek in the Hot Springs district, and carbonate-rock-hosted columbium and rare-earth minerals in the Tofty area were mapped and described. Bureau geologists made a brief reconnaissance of potential marine tin placers near Cape Prince of Wales on the Seward Peninsula. Other areas where tin occurrences are being studied are shown in figure 11 and listed in table 6. Barker and Swainbank (1985) report that an extensive area of porphyry

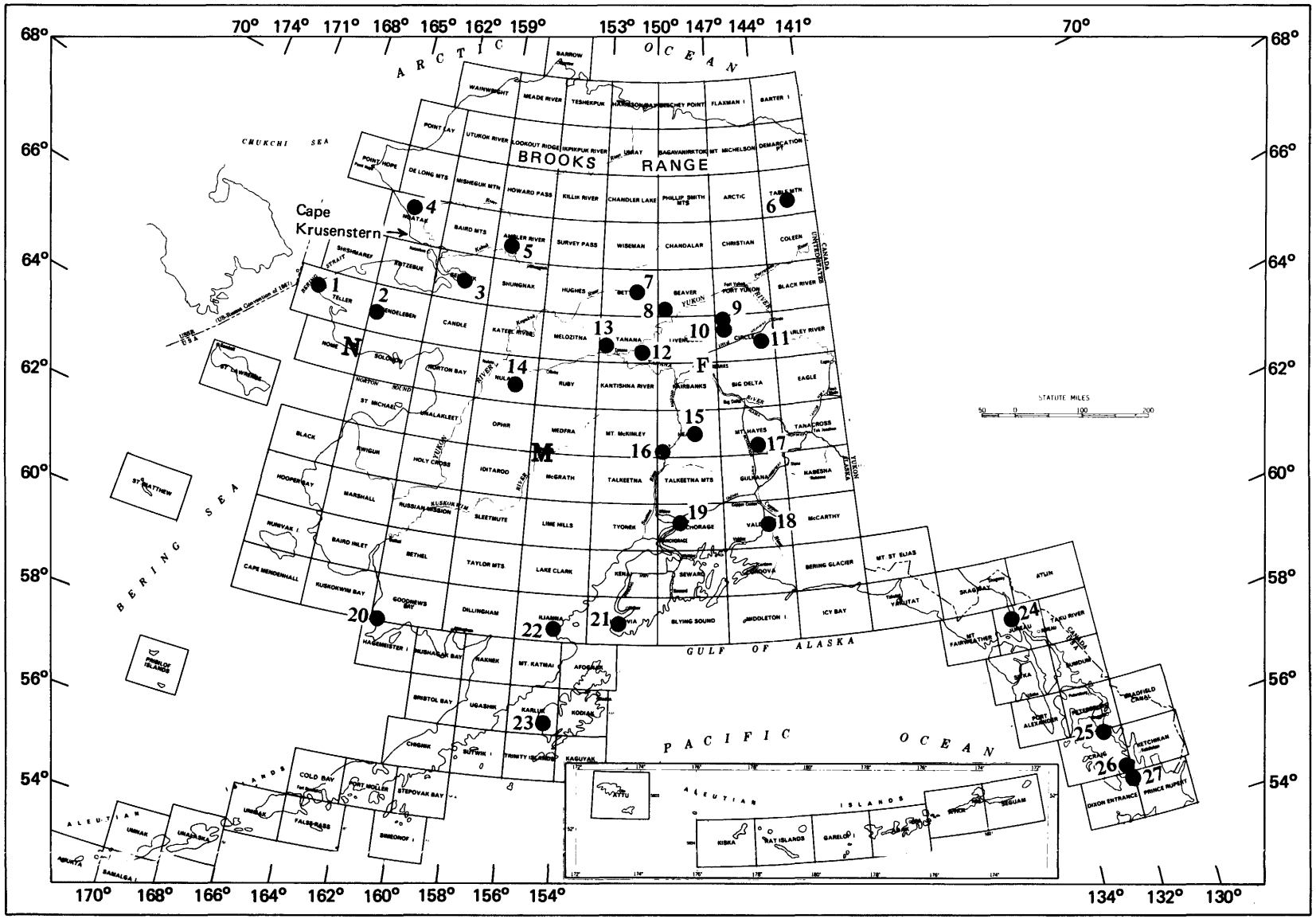


FIGURE 11.—Locations of Bureau of Mines 1985 studies of critical and strategic minerals.

TABLE 6.—*Areas of Bureau of Mines and U.S. Geological Survey activity in critical and strategic mineral in 1985 shown in figure 11* [PGM, platinum-group metals; * USGS project also in this area]

	Area	Element or mineral of interest
1.	Cape Prince of Wales, Cape Mtn.*	Tin
2.	Kougarok	Tin, columbium, tantalum
3.	Selawik Hills	Columbium, rare-earth minerals, fluorite
4.	Rabbit Creek	Copper, cobalt
5.	Bornite	Copper, cobalt
6.	Bear Mountain	Molybdenum, tungsten, columbium
7.	Kanuti region	Tin
8.	Ft. Hamlin Hills	Tin
9.	West Crazy Mts.	Zinc, copper, cobalt
10.	Lime Peak (Rocky Mtn.)	Tin
11.	Ketchum Creek	Tin
12.	Tofty	Rare-earth minerals, columbium
13.	Tozimoran Creek	Tin
14.	Kaiyuh Mts.	Chromium
15.	Sheep Creek	Lead, zinc, tin
16.	Chultina area	Tin
17.	Rainbow Mtn.	Copper, nickel, cobalt, PGM
18.	Tonsina	Chromium, PGM
19.	Eklutna	Chromium
20.	Goodnews Bay area	PGM, gold
21.	Red Mountain	Chromium
22.	Iliamna Bay	Copper, nickel, PGM
23.	Halibut Bay	Chromium
24.	William Henry Bay	Rare-earth minerals, columbium, uranium
25.	Salmon Bay	Rare-earth minerals, columbium
26.	Bokan Mountain	Rare-earth minerals, columbium, uranium
27.	Stone rock Bay	Rare-earth minerals, columbium, uranium

F, Fairbanks; M, McGrath-Takotna; N, Nome

molybdenum-tungsten mineralization near Bear Mountain in northeastern Alaska has by-product amounts of columbium. In southeastern Alaska, Bureau personnel are investigating and sampling columbium and rare-earth mineral deposits at Bokan Mountain, Stone Rock Bay, and Salmon Bay. Columbium, fluorite, and rare-earth-mineral deposits were also mapped in the Selawik Hills of western Alaska (Barker, 1985).

A final summary of Bureau chromium investigations (Foley and others, 1985) estimates that 2.8 million short tons of Cr_2O_3 in low-grade deposits are present near existing access routes in south-central Alaska, particularly near Tonsina, Eklutna, and at Red Mountain near Seldovia and Halibut Bay on Kodiak Island. Other occurrences are along the Kanuti River and in the Kaiyuh Mountains. This tonnage is equivalent to 6 years of domestic consumption at 1981 rates. The locations of chromium deposits are shown on figure 11.

Cobalt occurs in a variety of mineralogical associations. A significant amount of cobalt is present in the Bornite copper deposit (fig. 11). The Albany Research Center is working on methods to recover this cobalt. Recent Bureau studies have identified other sites favorable for cobalt deposits in the White Mountains area north of Fairbanks, in the Cape Krusenstern area (Barker and Roberts, 1985), and in the western Brooks Range. See figure 11 for other localities known to contain cobalt.

The AFOC, in cooperation with other Bureau Research Centers, arranged for members of the Tuscaloosa (Ala.) center to observe placer mining in selected areas of Alaska. The objective of this activity is to determine if Bureau dewatering techniques developed for the phosphate industry in Florida might be applicable to problems faced by Alaskan placer miners in their attempts to meet turbidity standards for water discharged from their operations. The Bureau is conducting several demonstration projects that will test these techniques in 1986. In addition, a panel of scientists from the Bureau's Spokane (Wash.) center conducted meetings in Alaska to solicit opinions from the mining community about research needs that could be addressed by the Bureau to assist in restoring a viable industry. Ideas garnered during the meetings may help to justify additional funding for mining research.

Bureau of Land Management

The Bureau issued five mineral patents in 1985 for 31 gold placer mining claims. A total of 599.315 acres was conveyed. These claims are in the McGrath-Takotna, Fairbanks, and Nome areas, shown in figure 11.

The *National Wildlife Federation v. Burford et al.* lawsuit concerning land withdrawals and classifications specifically affects areas of the Seward Peninsula opened to oil and gas leasing and the mining laws under the authority of Section 204(a) of the Federal Land Policy and Management Act, by Public Orders 6477 and 6559 of October 5, 1983, and August 9, 1984, respectively. The Injunctive Order effective February 14, 1986, does not affect third parties but enjoins the Department of the Interior from: (1) revoking withdrawal or termination classifications in existence as of January 1, 1981; (2) taking actions inconsistent with specific terms of the above withdrawals or classifications; (3) suspends all revocations of withdrawals and terminations of classifications completed after January 1, 1981; (4) allows the Department to accept filings required by law; and (5) exempts Alaska from the order where lands affected are for Native or State conveyances. Essentially, for the Seward Peninsula area, any pending offers on oil and gas leases will be suspended, and no new offers will be considered. Mining Plans of Operation may not be approved if the lands were not open to location on January 1, 1981, and the lands remain closed to the full operation of the mining laws. However, many areas were open to the location of metalliferous minerals under the terms of the withdrawals in effect prior to January 1, 1981.

National Park Service

The National Park Service has significantly increased its budget and staff to implement a minerals-management program that is consistent with Federal regulations for implementation of the 1872 Mining Law and the Mining in the Parks Act of 1976. The National Park Service will do an environmental assessment for all submitted plans of operations. Additionally, the National Park Service will prepare minerals management plans and EISs for the minerals management program in Denali National Park and Preserve, Yukon-Charley Rivers National Preserve, and Wrangell-St. Elias National Park and Preserve.

Department of Agriculture—Forest Service

One of the large mining developments in southeast Alaska, Greens Creek, is in the Admiralty Island National Monument, which is administered by the Tongass National Forest. Noranda Mining, Inc., in order to facilitate exploration of the ore body, requested that the Forest Service adjust the boundary of the monument so that the Greens Creek project would be excluded from that area. The Forest Service prepared an EIS on Noranda's request, but no decision on the EIS was made because Alaska's congressional delegation subsequently introduced successful legislation responsive to Noranda's proposal.

U.S. Borax and Chemical Corporation's Quartz Hill molybdenum deposit is in Misty Fiords National Monument on a 152,000-acre tract that is excluded from designation as wilderness. The Forest Service was the lead agency for the Draft EIS released in 1984; a revision to this report has been necessitated by U.S. Borax's providing additional information about marine tailings disposal. The revised draft is scheduled for release early in 1986, and the Final EIS is to follow in the summer.

The Forest Service is preparing to update minerals-related data for revision of the Tongass Land Management Plan, scheduled for completion in 1989 and covering the forest area in southeastern Alaska. Mineral resource data, including areas of mineral interest, claim staking and exploration activity, and field investigations such as the U.S. Geological Survey's AMRAP, will be used to update the existing data base. This information will in turn be used to determine the areas of the Tongass National Forest where mineral exploration and development is most likely to occur and to integrate minerals-related activities into the land management process.

U.S. Fish and Wildlife Service

In keeping with its primary mission, efforts of the Service relating to mineral activity emphasize fish, wildlife and habitat protection. However, some mining claims were located before refuges were established. As of December 1985, Bureau of Land Management records showed about 1,000 placer, lode, and tunnel site claims in 12 Alaskan national wildlife refuges (NWRs). Of these, about 400 lode and 150 placer claims were ascribed

active status. Most are in the Togiak, Alaska Peninsula, Innoko, and Yukon Delta NWRs (fig. 2). On the Togiak NWR, a mineral survey has been made and approved for 40 placer claims near Goodnews; application for patent will probably ensue. Mineral survey applications also remain authorized for six lode claims in the Alaska Maritime NWR near the Apollo mine on Unga Island.

A technical assistance report was prepared jointly by the Fish and Wildlife Service and the National Marine Fisheries Service, leading to the consideration of less environmentally damaging alternatives for the Draft EIS for the Quartz Hill mine plan. At the ore-loading facility at Skagway, Fish and Wildlife Service and Alaska Department employees investigated heavy metal contents of sediment and fauna. Concentrations of lead, zinc, cadmium, copper, and mercury in the sediment in the harbor were higher than in a control area outside the harbor. Also, the concentrations of lead and zinc were greater in the blue mussel (*Mytilus edulis*) from inside the harbor than in specimens from the control area (Robinson-Wilson and Malinky, 1986).

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