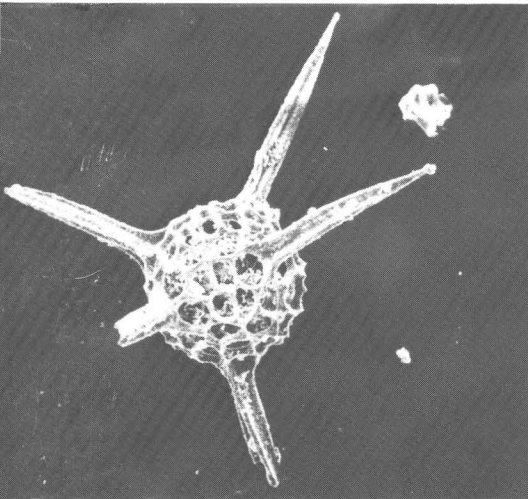


# THE U.S.GEOLOGICAL SURVEY IN **ALASKA**--1982 Programs



Cover photographs, clockwise from upper left:

Aerial view of gravel island drilling site, Beaufort Sea

Surveying for the National Mapping Division, Kachemak Bay area

Stream sampling in Lignite Creek, south of Fairbanks

Remote-sensing class instruction, EROS Field Office, Anchorage

Fieldwork in the Noatak River valley; DeLong Mountains in the background

Radiolarian from an Upper Devonian to Pennsylvanian chert-rich "black ball"  
unit in the Talkeetna C-6 quadrangle, Alaska Range

THE U. S. GEOLOGICAL SURVEY  
IN **ALASKA**

1982 PROGRAMS

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GEOLOGICAL SURVEY CIRCULAR 867

1982

**UNITED STATES DEPARTMENT OF THE INTERIOR**  
**JAMES G. WATT**, *Secretary*



**GEOLOGICAL SURVEY**  
**DALLAS L. PECK**, *Director*

Free on application to Distribution Branch, U.S. Geological Survey, 604 South Pickett Street,  
Alexandria, Va. 22304 and Public Inquiries Office, 508 Second Avenue, Anchorage, AK 99501.



## ABOUT THIS CIRCULAR

This Circular describes the Fiscal Year (FY) 1982 programs and projects of the U.S. Geological Survey and of the Minerals Management Service in Alaska. The Minerals Management Service was established by order of the Secretary of the Interior on January 19, 1982. Formerly the U.S. Geological Survey, Conservation Division, the Minerals Management Service is responsible for managing the Federal royalty program, continuing the functions of the Conservation Division, and implementing policies developed by the newly established Minerals Management Board.

A brief description of the Alaskan operations of each office and division of the Survey and of the Service is followed by project descriptions arranged by geographic regions in which the work takes place. A directory at the end of this booklet (table 3) lists all project chiefs in alphabetical order and summarizes other general information. Also in the back of this booklet is a listing (table 4) of cooperating agencies.

A companion Circular, 868, consists of articles describing significant accomplishments of the Survey's topical and field investigations in Alaska during 1981.



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## CONVERSION TABLE

U.S. customary units used in this report may be expressed as metric units by use of the following conversion factors.

<u>Multiply</u>	<u>By</u>	<u>To obtain</u>
foot	0.3048	meter
mile	1.609	kilometer
pound	0.4536	kilogram
ton	0.9072	tonne, megagram
square mile	2.589	square kilometer
square foot (or foot squared)	0.0929	square meter
per day		per day
gallon	3.785	liter
cubic foot	0.02831	cubic meter

Metric units used in this report may be expressed as U.S. customary units by use of the following conversion factors.

<u>Multiply</u>	<u>By</u>	<u>To obtain</u>
meter	3.281	foot
kilometer	0.6214	mile
kilogram	2.205	pound
megagram	1.102	ton
square kilometer	0.3861	square mile
square meter per day	10.76	square foot per day
liter	0.2641	gallon
cubic meter	35.31	cubic foot

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# THE U. S. GEOLOGICAL SURVEY IN ALASKA

## THE CHALLENGE

Alaska programs of the Survey are expanding and changing in response to the Nation's need for energy and minerals, advancing technology, and passage of the Alaska National Interest Lands Conservation Act (ANILCA) in December 1980. By that act, Congress made fundamental decisions on the ownership and management of Alaska's vast lands.

Alaska is at once the largest and the least populated, least explored, and least developed of the Nation's States. The land area contains 375 million acres and comprises 16 percent of the on-shore land and more than half of the Outer Continental Shelf (OCS) of the Nation. After Native and State of Alaska land selections of 44 million acres have been made, approximately 60 percent, 225 million acres, of Alaska land will remain under Federal jurisdiction. Federal lands in Alaska then will comprise approximately 30 percent of all onshore land in the Nation's public domain.

In a sense, the Geological Survey in Alaska in the 1980's faces the challenge it faced 100 years ago when it set out to map and assess the public domain. From this perspective, the 1980's will be a critical decade for resource exploration and appraisal in Alaska; although most of Alaska has been explored on a reconnaissance level, much work remains to be done to appraise its resources in more detail.

Declining oil and gas reserves in the United States and worldwide have caused an increase in the value of petroleum reserve units, and this change, coupled with advances in technology, has made many of the Alaskan resources economically competitive with resources elsewhere in the world. Demand for and increased cost of petroleum have brought Alaska into the forefront. In addition, Alaska's reserves are available from a politically stable area, and they tend to reduce the balance of payments deficit. Currently, 18 percent of domestic oil production is from Alaskan fields.

It is probable that, in the decade ahead, exploration for and production of Alaska's other mineral resources will follow a pattern similar to that of petroleum resources as demand and costs rise owing to global political conditions and declining reserves.

The Geological Survey is therefore challenged with evaluating Alaska's resources so that they can be used wisely for the benefit of the Nation's citizens and with providing information on the environmental effects associated with such development.

## PUBLICATIONS OF THE U. S. GEOLOGICAL SURVEY

The Geological Survey publishes several types of reports that describe the results of projects or programs or that are the products of a Division's work. These reports range from books to preliminary maps.

Survey publications can be purchased at two offices in Alaska. The Public Inquiries Office (PIO) at 508 Second Ave., Anchorage, sells book reports and many kinds of maps relating to Alaska. It also acts as a depository for Open-File Reports about Alaska and maintains a reference library of Survey publications and selected journals for public use. The Alaska Distribution Section in Room 126 of the Federal Building in Fairbanks provides maps of Alaska both by mail and over the counter. Alaska maps are also available from the Distribution Branch, Box 25286, Federal Center, Denver, Colo. 80225.

Listings of Survey reports and maps, but not including Open-File Reports, are available in "Publications of the Geological Survey 1879-1961" and "Publications of the Geological Survey 1962-1970"; these can be purchased for \$2.00 each. Each month the Survey prints a catalog "New Publications of the Geological Survey," which contains a list of new reports and maps released during the month. At the end of each year these lists are compiled in a single volume. Both the monthly catalogs and the annual lists released since 1970 are available free from the PIO, as are request forms for the monthly catalogs. The Survey began listing Open-File Reports in its 1974 catalog; information about older reports of this type is available from the PIO.

A list of publications (except Open-File Reports and Water-Resources Investigations) that describe geology or hydrology of Alaska and that were released before August 1980 may also be obtained, at no charge, from the PIO or the Alaska Distribution Center; updated information is available on request at both offices.

Book reports, such as Professional Papers, Bulletins, Water-Supply Papers, Techniques of Water Resources Investigations, Water-Resources Data Reports, the Survey's annual Yearbook, and non-technical leaflets, can be ordered from the Distribution Branch, 604 South Pickett St., Alexandria, Va. 22304, or from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402. Not all Survey reports are still in print, and information about price and availability can generally be obtained from the PIO.

Most Open-File Reports and Water-Resources Investigations can be ordered from the Open-File

Services Section, Box 25425, Federal Center, Denver, Colo. 80225, in paper copy or microfiche form. Some Open-File Reports and Water-Resources Investigations are also available from the National Technical Information Service (NTIS), Springfield, Va. 22161. These are also in microfiche or paper copy. The PIO has prices for both NTIS releases and Open-File Reports.

Maps of Alaska are available at several scales; some maps have metric scales. Maps can be purchased at the PIO and at the Alaska Distribution Section; most cost \$2.00 or \$3.25 per sheet. Both of the Alaska offices provide free indexes that show the current status of orthophotoquad and topographic mapping in Alaska.

The Geologic Division's office in the O'Neill Building on the Fairbanks campus of the University of Alaska has a browse file of some Survey book-type reports.

Mailing addresses and telephone numbers for the two offices from which publications can be purchased are:

Public Inquiries Office  
508 Second Avenue  
Anchorage, AK 99501  
Tel. (907) 277-0577

and

Alaska Distribution Section  
Box 12, Federal Building  
101 12th Avenue (Room 126)  
Fairbanks, AK 99701  
Tel. (907) 456-7535

## **SOURCES OF ADDITIONAL INFORMATION**

For further information about the Geological Survey and Minerals Management Service activities in Alaska, please contact:

### **The Geological Survey**

Max Brewer, Acting Special Assistant to the  
Director for Alaska  
Room 216, Skyline Building  
218 E Street  
Anchorage, AK 99501  
Tel. (907) 271-4396

### **Office of Earth Science Applications**

Gene Thorley, Chief  
104 National Center  
12201 Sunrise Drive  
Reston, VA 22092  
Tel. (703) 860-7471

### **EROS Program**

David M. Carneggie, Chief  
Room 316, Skyline Building  
218 E Street  
Anchorage, AK 99501  
Tel. (907) 271-4065

### **National Mapping Division**

Paul D. Brooks, Chief, Alaska District  
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218 E Street  
Anchorage, AK 99501  
Tel. (907) 271-4148

### **Geologic Division**

Thomas P. Miller, Chief, Branch of Alaskan  
Geology  
Gould Hall, APU Campus  
University Drive  
Anchorage, AK 99504  
Tel. (907) 278-3571

### **Water Resources Division**

Philip A. Emery, Chief, Alaska District  
733 West 4th Avenue, Suite 400  
Anchorage, AK 99501  
Tel. (907) 271-4138

### **National Petroleum Reserve in Alaska**

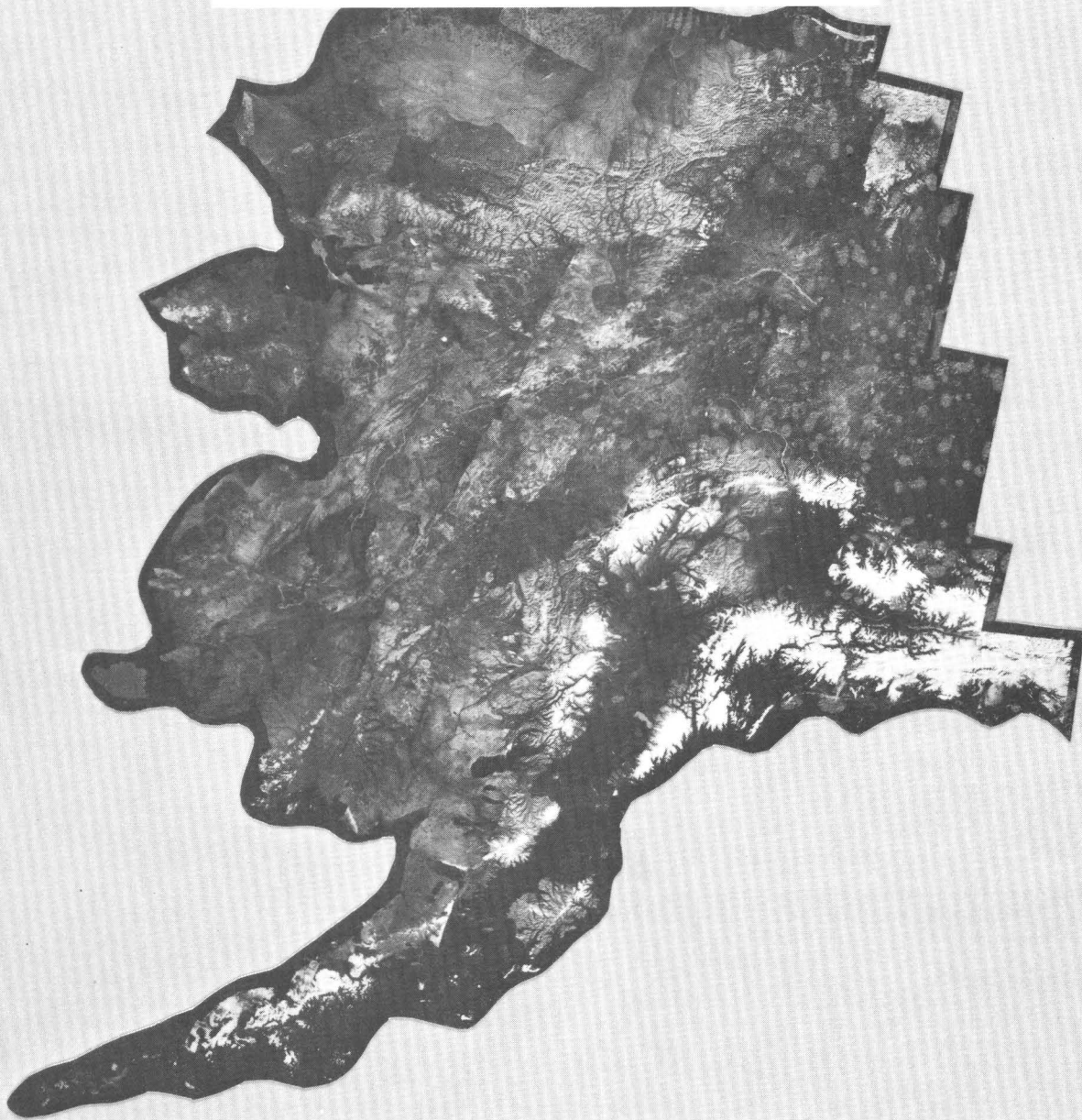
George Gryc, Chief  
2525 C Street  
Anchorage, AK 99501  
Tel. (907) 276-7422

### **Minerals Management Service**

Joseph A. Jones, Manager, Alaska Region  
800 A Street  
Anchorage, AK 99501  
Tel. (907) 271-4304



## Office of Earth Science Applications



Landsat mosaic map of mainland Alaska.

For further information, contact the offices listed below.

### Anchorage, Alaska

David Carnegie

Chief, USGS/EROS Field Office  
218 E Street, Anchorage, AK 99501  
Tel. (907) 271-4065

### Reston, Virginia

Gene A. Thorley

Chief, Office of Earth Science Applications  
104 National Center, Reston, VA 22092  
Tel. (703) 860-7471

## OFFICE OF EARTH SCIENCE APPLICATIONS

The Office of Earth Science Applications (OESA) coordinates and administers some inter-related and interdisciplinary programs of the Geological Survey and other bureaus in the Department of the Interior. The major objective of the Office's work is to interpret and display resource information so as to be readily accessible and understandable to a wide range of users.

An element of OESA is the Earth Science Assistance Office. Although no representatives of this office are stationed in Alaska, it plays an active part in the Survey's activities in the State. Much of this involvement consists of supplying funds and encouraging projects that seek to apply scientific knowledge to practical problems. In addition, the office coordinates activities that relate to such applications and has encouraged publication of information about the Survey's work nationwide. Information about the office's work in the western States can be obtained from:

William Kockelman  
U.S. Geological Survey  
345 Middlefield Road  
Menlo Park, CA 94025  
Tel. (415) 323-8111 ext. 2312

The Environmental Affairs Office (EAO) was established in 1975 to provide the Survey's response to environmental impact statement (EIS) preparation and review requirements of the National Environmental Policy Act (NEPA).

The Geological Survey usually becomes involved as a lead agency in the preparation of NEPA-related documents, including the preparation of EIS's, as a result of the Minerals Management Service's (formerly Conservation Division) supervision of mineral resource exploration, development, extraction, and reclamation operations on Federal lands. The Survey may also be a lead agency when activities of other divisions might require the preparation of an EIS. The Survey participates as a cooperating agency as a result of its supervisor function (as described above) and through its special expertise in the areas of geology, hydrology, and mining and petroleum engineering. Survey review of EIS's focuses primarily on the adequacy of descriptions of geologic and hydrologic environments, and of the analysis of related environmental impacts and mitigating measures and alternatives.

EAO, as the Bureau focal point for NEPA matters, provides an integrated Geological Survey response to the requirements of NEPA by: (1) developing NEPA-related policy and guidance for the Geological Survey; (2) ensuring the quality compliance with NEPA; (3) monitoring Bureau-wide compliance with NEPA; (4) reviewing and commenting on environmental documents prepared by other bureaus and agencies; (5) assisting in the performance of specialized studies in support of ongoing environmental analyses; (6) preparing environmental documents at the request of other agencies; (7) managing Geological Survey personnel

assigned to other agencies' EIS's; and (8) conducting research to improve the NEPA process.

Oilspill risk analyses to determine the relative environmental hazards of developing oil have been conducted by EAO since 1976 for the Geological Survey in different regions of the Alaskan Outer Continental Shelf. These studies analyze the probability of spill occurrences, likely paths of oil slicks, and locations of resources vulnerable to spilled oil. The combined results yield estimates of the probability of oilspill impacts occurring due to development of proposed lease areas. Analyses for the North Aleutian Basin (proposed sale 75) and Navarin Basin (proposed sale 83) are scheduled for release to the open file in March and December 1983, respectively.

The Coordinator, Coastal Zone Management Act, EAO, assisted in the preparation of a memorandum of understanding (MOU) between the State of Alaska and the Geological Survey regarding the consistency of Federal activities affecting Alaska's coastal zone. The MOU lists those activities that the two parties feel will not affect the coastal zone and describes in detail the steps necessary to review other activities. As a result of the regulatory simplification enhanced by this MOU, similar MOU's are now being negotiated in other coastal States.

The Geological Survey is preparing an EIS on the oil and gas exploration regulations for the Arctic National Wildlife Refuge which is scheduled to be completed in August 1982.

Additional information on the EAO may be obtained from:

Chief, Environmental Affairs Office  
U.S. Geological Survey  
760 National Center  
Reston, VA 22092  
Tel. (703) 860-7455

The office is developing standardized directories of natural resource development permits for most States. Permit requirements for 18 elements of such development, including energy resources and air and water quality, are included. The standardized format facilitates easy State-by-State comparison of permit requirements. The permit directory for the State of Alaska is now available. For information about the directory, contact:

Gina Sanders  
Alaska Department of Energy and Conservation  
437 E Street, 2d Floor  
Anchorage, AK 99501  
Tel. (907) 279-0254

A third major segment of OESA is the Earth Resources Observation System (EROS), whose work in Alaska is described below.

## EARTH RESOURCES OBSERVATION SYSTEM (EROS) PROGRAM

The EROS Program was established by the Department of the Interior in 1967 to assist in

realizing the practical benefits to earth-resource and environment inventory and monitoring of using aerial photographs and other remotely sensed data acquired by aircraft and spacecraft, including the Landsat satellite. The EROS program office is located in the Geological Survey's National Center in Reston, Va. The program operates a national archive for aerial and space photographs at the EROS Data Center in Sioux Falls, S. Dak. That facility is responsible for distributing Landsat imagery, computer-compatible tapes, Survey aerial photographs, and other forms of remotely sensed data to users throughout the world. The center also assists government agencies in applying remote-sensing techniques to various kinds of resource problems. Inquiries on specific problems about remote-sensing technology, including training opportunities, should be addressed to the Branch of Applications at the Data Center, Sioux Falls, SD 57198; the telephone number is (605) 594-6511.

In November 1974, an EROS Applications Assistance Facility was opened in Fairbanks to assist users to determine the availability of aircraft and spacecraft imagery and to handle image and photograph orders. This facility is at the Geophysical Institute, University of Alaska. Interpretation equipment, including a color-additive viewer, zoom transfer scope, and variable magnification stereoscope, is available there. In addition, the Fairbanks files contain selected Landsat images, National Aeronautics and Space Administration (NASA) and other aerial photographs, and other remotely sensed data for Alaska. In October 1981, administration of the facility was transferred from the EROS Program to the Geological Survey's National Cartographic Information Center. For information concerning the Fairbanks facility, contact Katherine Martz at (907) 479-7484, or Cheryl Hallam at (907) 271-4159.

The EROS Data Center opened a Field Office in Anchorage in March 1980 to expand its programs for transferring remote-sensing technology to Department of the Interior and other Federal, State, and local government agencies. The USGS-EROS Field Office has an Interactive Digital Image Manipulation System (IDIMS) to assist in automating the analysis of Landsat data. The primary objectives of the Field Office are to provide training in manual and automated analysis of remotely sensed data for resource inventory and to make the analysis equipment available to resource managers from government agencies in Alaska. To accomplish its mission, the Field Office will:

- \* Assist government personnel to increase their understanding and use of remote-sensing techniques for resource assessment through a variety of training programs.
- \* Encourage resource agencies to develop or implement their own remote-sensing analysis capability consistent with their resource assessment needs.
- \* Encourage each resource agency to train one or more of its employees to be remote-sensing data analysts capable of using manual and digital analysis equipment available at the Field Office.

- \* Operate a state-of-the-art digital analysis laboratory that is available to resource management agencies for their operational inventories.

Since opening the USGS-EROS Field Office, the staff has given more than 60 demonstrations of the digital analysis system, assisted in or conducted seven 2-to-5-day training courses, and worked on cooperative projects with the National Park Service, the U.S. Forest Service, and the U.S. Fish and Wildlife Service on vegetation mapping projects. In addition, personnel from the following agencies or institutions used the digital analysis system for their own inventory or project work: Bureau of Land Management, Soil Conservation Service, National Park Service, University of Alaska, U.S. Forest Service, National Aeronautics and Space Administration, and the Alaska Department of Natural Resources. EROS personnel also have assisted in two research projects conducted by the University of Alaska, Fairbanks; one studied the effect of seasonality on the mapping of vegetation, and the other examined enhancement techniques for studying geologic lineaments.

The Field Office is staffed by six full-time scientists, but it calls on EROS Data Center personnel, analysis techniques, and software as required to address Alaskan needs. Several training courses on remote-sensing techniques will be offered in FY 1982 in the disciplines of land cover and vegetation mapping, geologic assessment, and an introduction to digital analysis techniques.

The USGS-EROS Field Office has a variety of stereoscopes and light tables to support its training programs. In addition, it has several kinds of state-of-the-art equipment for analyzing remotely sensed data. The IDIMS equipment will be used for training, as well as operationally, to digitally display, enhance, classify, and manipulate Landsat data. The Field Office also has two film recorders. One recorder allows the user to produce geometrically correct and enhanced Landsat images, and both film recorders are also used to produce cover maps. Finally, the Field Office has a stereo zoom transfer scope which transfers interpretive resource overlays from remotely sensed data to maps.

During the next 5 years, the Field Office mission will focus on remote-sensing training and operational support of resource inventory and assessment for government users, especially those responding to inventory requirements mandated by the Alaska National Interest Lands Conservation Act (ANILCA). EROS therefore will devote more effort to Department of the Interior and Geological Survey needs. In addition, increased attention will be given to operational research and development of remote-sensing techniques to meet inventory needs in Alaska. The Digital Analysis laboratory will continue to be available to all government agencies for their operational inventories, and EROS Field Office staff will provide analytical services for Interior bureaus and offices that do not have personnel trained to use the analysis equipment of the Field Office. The Field Office will maintain a direct communication link with the EROS Data Center for the acquisition of digital Landsat data, existing Landsat data, supporting resource information

formatted to 1:250,000-scale quadrangles and to other appropriate jurisdictional boundaries, and other forms of digital data, such as digital terrain data that have been tailored to meet Department of the Interior needs in Alaska. EROS personnel will work with other Government agencies to explore needs for and (or) installation of a remote terminal link to the Field Office digital analysis system or other Landsat processing capability to be implemented in the State.

The Field Office will work closely with the Geological Survey's National Cartographic and Information Center (NCIC) recently established in Anchorage and the NCIC facility at the University of Alaska in Fairbanks to provide information on the availability of remotely sensed data and its uses. A microfilm browse file of Landsat imagery is available for public inspection at the Public Inquiries Office of the Survey, Room 108, Skyline Building, 508 Second Avenue, Anchorage 99501. The USGS-EROS Field Office is located on the third floor of the Skyline Building at the corner of Second Avenue and E Street. For more information, contact the Field Office Chief, David M. Carneggie, 218 E Street, Anchorage 99501, or phone (907) 271-4065.

## EROS PROJECTS

With the exception of the Statewide projects below that describe the operational uses of the Field Office's digital analysis equipment and the training program, all project locations are shown on figure 1.

### STATEWIDE

Project Title: Operational Use of USGS-EROS Digital Analysis System for Vegetation Classification Using Landsat Data

Chiefs: David M. Carneggie and Michael D. Fleming

Objectives: To maintain and operate an interactive digital image manipulation system (IDIMS) for automating vegetation-cover classification of Landsat data. The IDIMS is available at an hourly fee to all Federal, State, and local agency personnel qualified to use the system. The EROS Field Office staff provides training to those who wish to use the system.

Status: The Field Office IDIMS consists of a Hewlett-Packard 3000 Series III computer, an array processor, three tape drives, four 120-Mbyte disks, a digitizer, a line printer, a printer plotter, and an interactive color display monitor. A second color display will be on line early in the summer of 1982. Since October 1981, the demand for the IDIMS by as many as five users has necessitated operating the system for one and a half to two shifts per day. The primary operational users include: Bureau of Land Management, which uses the system to develop digital data bases for the National Petroleum Reserve in Alaska, land-cover maps for the North Slope, and materials to support their remote-sensing training courses; the Alaska Department of Natural Resources, Division of Research and Development, which uses the system to produce land-cover maps for 30 million acres in the Bristol

Bay region in cooperation with the U.S. Fish and Wildlife Service; the U.S. Forest Service, which is classifying land cover at all grid intersections from a 5,000-meter grid in the western half of the Tanana River watershed; and the University of Alaska, Geophysical Institute, Fairbanks, which has been involved in a variety of land classification and geologic research projects, with funding support from the National Aeronautics and Space Administration and EROS.

In addition, the system is used to support training activities and cooperative projects with other government agencies. EROS personnel, as well as operational users, are using IDIMS to process and reformat digital terrain data from 1:250,000-scale Survey quadrangles. The terrain data is being mosaicked and registered to a 50-meter UTM grid for each of the 1:250,000-scale quadrangles in Alaska.

The Field Office does not require operational users to produce documents detailing their procedures and results. Information regarding these projects can be obtained by contacting the agency involved.

Project Title: EROS Field Office Remote-Sensing Training Program

Chief: David M. Carneggie

Objective: To provide training in the use of remote-sensing data and techniques for resource inventory and assessment. Training courses are offered to satisfy needs identified in Alaska or at the request of a government agency.

Status: Field Office and EROS Data Center personnel will conduct at least three one-week remote-sensing training courses in FY 1982. Course topics include a remote-sensing course for geologic and hydrologic applications; an introduction to digital analysis techniques; and the use of remotely sensed data for land-cover mapping. Shorter workshops and seminars can be conducted on request. Courses are designed to introduce the principles of remote-sensing data acquisition and analysis and to demonstrate the application of remote-sensing technology for resource inventory and assessment. Courses are primarily for government agencies, but participants from the private sector may attend on a space-available basis. The Field Office also hosts training courses conducted by other agencies and provides instructors where appropriate.

### WEST-CENTRAL REGION

Project Title: Development of a Geologic Digital Data Base for the Bendeleben and Solomon Quadrangles

Chiefs: James E. York (EROS) and Alison Till (USGS, Geologic Division)

Objectives: To demonstrate the usefulness of enhanced Landsat imagery and color-infrared aerial photographs, and to develop a digital geologic (geochemistry, aeromagnetism, gravity, and lithology) data base for assessing mineral potential.



#### EXPLANATION

1. Effects of Date and Phenology on Classification of Alaska Vegetation
2. Vegetation Classification Using Landsat Data for Renewable Resources Evaluation Research for Alaska
3. Land-Cover and Terrain Mapping on the Kenai National Wildlife Refuge
4. Land-Cover and Terrain Mapping on Togiak National Wildlife Refuge
5. Land-Cover and Terrain Mapping in the Bristol Bay Region
6. Development of a Geologic Digital Base for the Bendeleben and Solomon AMRAP Area

Figure 1.--Office of Earth Science Applications activities in Alaska carried out by the EROS Program.

Status: Enhanced and enlarged (1:63,360-scale) Landsat images of the Bendeleben and parts of the Solomon quadrangles were produced early in FY 1982 for planning field activities during the summer of 1982. High-altitude color-infrared aerial photographs also were acquired for preliminary interpretation of lithology and structure and for use as a base for recording field observations. Existing terrain (elevation, slope, aspect), geochemical, aeromagnetic, and gravity data are being digitized for entry into a digital data base. As more geochemical and geologic data become available, they too will be entered. The digital data base will be used to test models derived to identify target areas of high potential for the known minerals in the area.

### EAST-CENTRAL REGION

Project Title: Effects of Date and Phenology on Classification of Alaska Vegetation Using Landsat Data

Chiefs: Donald T. Lauer (EROS) and John Miller (Univ. of Alaska)

Objectives: To conduct remote-sensing research to assist resource managers using Landsat data to classify vegetation. The research is oriented toward determining the optimum dates on which to obtain Landsat data in order to produce the most accurate vegetation maps. The test area will include representative vegetation from Alaska's interior. The results will be particularly useful for large cover-mapping projects, such as for National Parks and Wildlife Refuges.

Status: Seven cloud-free Landsat scenes that represent dates prior to, during, and following the growing period at a test site northeast of Fairbanks have been selected and processed. The Interactive Digital Image Manipulation System (IDIMS) was used in early FY 1982 to produce statistics (mean, standard deviation, and covariance matrices) for various cover types based on four bands of Landsat Multi-spectral Scanner data for each date. The statistics were produced from training sites selected by the analyst. A comparison of the statistics for different cover types on a given date and for the same cover type on several dates was made to determine the best time to obtain imagery for discriminating land-cover types. A preliminary assessment shows that differences between cover types in the test area are greatest during early July. Moreover, the study showed that the optimum date for digital analysis may not be optimal for manual analysis.

Project Title: Vegetation Classification Using Landsat Data for Renewable-Resource Evaluation Research

Chiefs: Mark B. Shasby (EROS), Vernon LaBau (U.S. Forest Service), Michael D. Fleming (EROS), and Ken Winterberger (U.S. Forest Service)

Objective: To determine the accuracy of classifying vegetation at sample points by digital analysis of Landsat data. The U.S. Forest Service is compar-

ing Landsat data, aerial photographs, and vegetation samples to determine optimum sampling procedures to collect data for the National Resource Inventory of the western half of the Tanana River basin.

Status: Vegetation-cover maps have been produced for sample plots (20 acres each) that represent the intersections from a 5,000-meter grid superimposed on the western half of the basin. The maps were produced using digital analysis procedures on the USGS-EROS Field Office Interactive Digital Image Manipulation System. Forest Service personnel will compare these maps with ground data and aerial photographs to assess classification accuracy.

### SOUTHWESTERN REGION

Project Title: Land-Cover and Terrain Mapping in the Bristol Bay Region Using Digital Landsat Data

Chiefs: Mark B. Shasby (EROS), Merlin Wibbenmeyer (Alaska Department of Natural Resources [ADNR]) and Jess Grunblatt (ADNR)

Objectives: To produce land-cover maps for the Bristol Bay region (approximately 30 million acres).

Status: The study originated in FY 1981 as a cooperative project between EROS and the State's Department of Natural Resources. EROS provided training to ADNR personnel and assisted in preprocessing and classifying four of 12 Landsat scenes. ADNR personnel completed preprocessing of the 12 scenes in December 1981. Preprocessing of digital terrain data was completed in January 1982, and preliminary classifications were completed in February 1982. Final land-cover maps for the region are expected by mid-1982. Map scales will be 1:250,000 and 1:63,360. Digital Landsat cover classifications and terrain data for each 1:63,360-scale quadrangle will be transferred to ADNR's digital data base at the end of the project.

Project Title: Land-Cover Mapping in the Togiak National Wildlife Refuge

Chiefs: David M. Carneggie (EROS), Mark D. Shasby (EROS), Michael B. Fleming (EROS), and Steven Talbot (U.S. Fish and Wildlife Service)

Objectives: To demonstrate the feasibility of producing a land-cover and terrain map using digital Landsat and terrain data, and to develop a digital data base for use in preparing a comprehensive plan for the Togiak National Wildlife Refuge. The study seeks to determine the cost effectiveness and accuracy of using digital Landsat data in conjunction with field data to produce land-cover maps. Digital terrain data will be used to improve cover classification and to produce terrain maps (elevation, slope, aspect).

Status: Land-cover and terrain maps at a scale of 1:250,000 have been produced for the U.S. Fish and Wildlife Service to be used in a comprehensive plan for the refuge (approximately 4 million acres). These maps were made available to the Bristol Bay Mapping Project of the Alaska Department of Natural



Resources as input to the comprehensive plan for the Bristol Bay Subregion as mandated by Title 2 of the Alaska National Interest Lands Conservation Act. Processing of digital Landsat (four scenes) and terrain data was completed by January 1982. The digital land-cover and terrain data are available for each of the Survey's 1:63,360-scale quadrangles in the refuge, and maps at this scale can be produced by either the EROS Field Office or U.S. Fish and Wildlife Service. The land-cover and terrain data will be transferred to digital data bases of the Alaska Department of Natural Resources and the U.S. Fish and Wildlife Service.

### SOUTHERN REGION

**Project Title:** Land-Cover and Terrain Mapping in Kenai National Wildlife Refuge

**Chiefs:** Mark B. Shasby (EROS) and Steven Talbot (U.S. Fish and Wildlife Service)

**Objectives:** To demonstrate the feasibility of producing land-cover and terrain maps using digital Landsat data and terrain data, and to develop a digital data base for use in preparing a comprehensive plan for the Kenai National Wildlife Refuge. The study seeks to determine the cost effectiveness

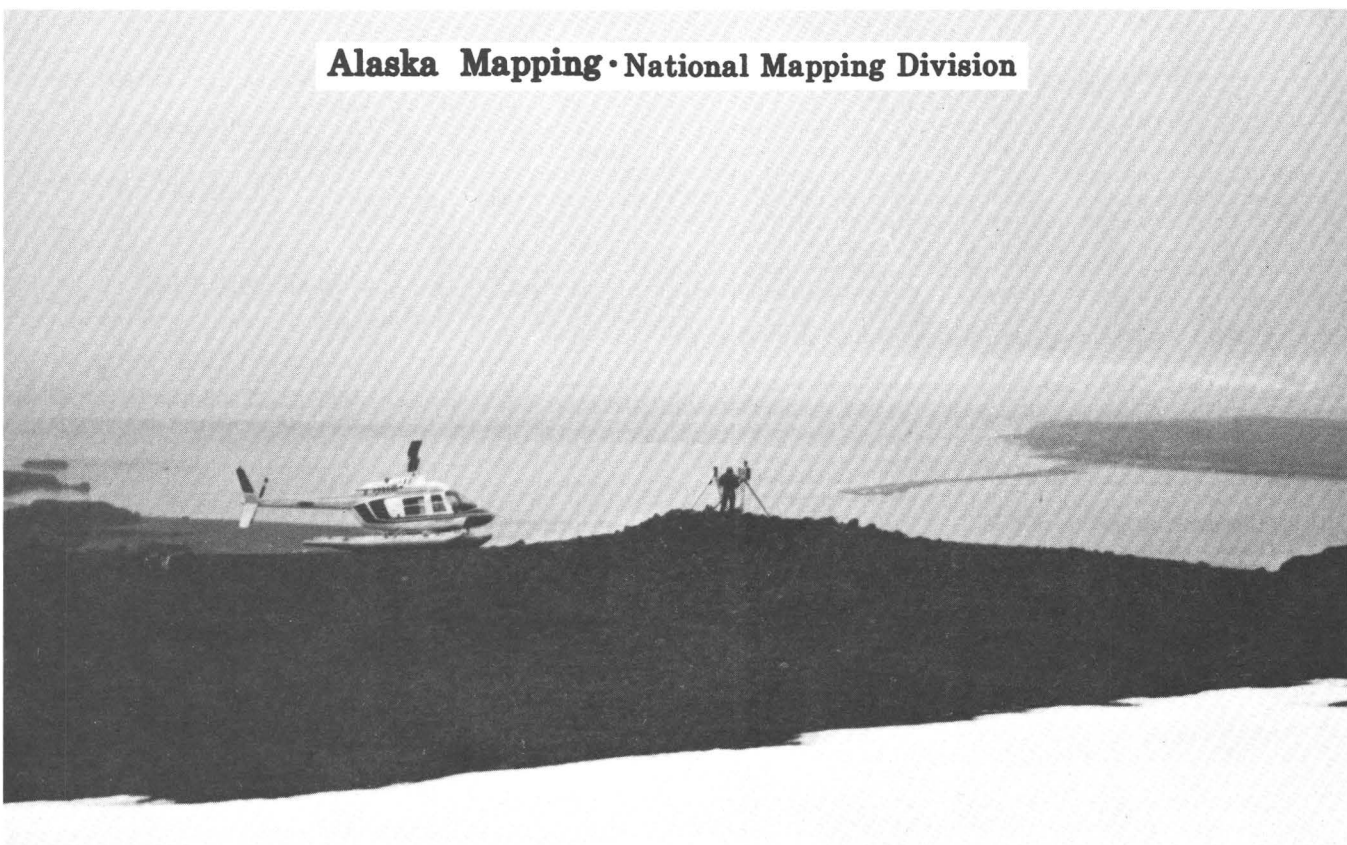
and accuracy of using digital Landsat data in conjunction with field data collection to produce land-cover maps. Digital terrain data will be used in the study to improve cover classification and to produce terrain maps (elevation, slope, aspect).

**Status:** Processing of two Landsat scenes and digital terrain data was completed in November 1981. Land-cover and terrain maps of the refuge (approximately 2.5 million acres) at a scale of 1:250,000 have been produced for the U.S. Fish and Wildlife Service to be used in the comprehensive plan in preparation for the refuge. The maps are being evaluated in terms of accuracy and cost effectiveness. Land-cover and terrain data for each of the Survey 1:63,360-scale quadrangles in the refuge are part of the Field Office digital data base, and these maps, as well as combinations of these types of data, can be produced on request. The digital data base for the refuge also includes Spetzman's vegetation maps (available at 1:250,000 for most quadrangles in Alaska and for viewing at the Department of the Interior's Alaska Resources Library, 701 C Street, Anchorage) and surficial geology. All digital resource data produced in this study will be transferred to the U.S. Fish and Wildlife Service digital data base at the completion of the study in late winter 1982.





## Alaska Mapping • National Mapping Division



Surveying on the south side of Kachemak Bay; Homer Spit in the background.

For further information, contact the offices listed below.

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### ALASKA MAPPING

The National Mapping Division is responsible for the preparation of maps, map products (including digital cartographic and geographic data) and research for the National Mapping Program. The Division also operates the National Cartographic Information Center (NCIC) which provides information on maps, aerial and space imagery, geodetic control, and other cartographic data.

The Alaskan mapping program field activities are managed by the Chief, Alaska Office, with operational management support being provided by the Chief, Rocky Mountain Mapping Center in Denver, Colo., and the Chief, Eastern Mapping Center in Reston, Va. The Alaska Office, located in Anchorage, gathers and maintains files on cartographic material used in mapping. In addition, this office provides technical assistance in mapping to Federal and State agencies and to the public in obtaining cartographic data, photographic products, geodetic control, and base-map materials.

Topographic maps at a scale of 1:63,360 (1 inch = 1 mile) with contour intervals expressed in feet are available for about 85 percent of Alaska. Maps of an additional 10 percent of the State are in various stages of production at 1:63,360 scale with contour intervals in metric units.

The Division plans to provide 1:25,000-scale (metric) maps for the agricultural, industrial, and urbanized areas of Alaska. Maps of the Anchorage area were published in FY 1980. Other areas for which maps are being prepared include Valdez, Seward, Cordova, Whittier, Willow, North Kenai, and, in newly authorized projects, Homer, Talkeetna, and Kodiak.

The Division also prepares for each State indexes that show the topographic maps that have been published. The Alaska index is available free from the Division's Public Inquiries Office, Room 108, Skyline Building, 508 Second Avenue, in Anchorage and the Map Distribution Office, Federal Building, Box 12, 101 Twelfth Avenue, in Fairbanks. In addition, a periodic index of publication status is also available free. For detailed information on revisions or current mapping status of specific areas, contact the Alaska Office, 218 E Street, in Anchorage.

The National Mapping Division will continue to support the production of land plats of the public lands surveys of the Bureau of Land Management (BLM) in Alaska through the preparation of orthophoto products. In the past, the Division has provided horizontal geodetic control, but this support is no longer needed because BLM has developed sufficient capacity of their own. The Division also continues its supportive role in the State-Federal interagency program to obtain uniform high-altitude aerial photograph coverage for the entire State. This program will provide the photographic data base for map revision, orthophotoquad, and land-use - land-cover mapping programs. Under a jointly funded agreement with the State of Alaska, Department of Natural Resources (DNR),

the Division is preparing orthophotoquad maps for selected high-priority areas in support of the State's Land Dispersal Programs. In addition, the Division has recently negotiated an agreement with DNR to provide technical assistance for the Alaska Resource Assessment Program.

### PROJECTS OF THE NATIONAL MAPPING DIVISION

Projects of the National Mapping Division are described below. Those listed under the heading "Statewide" are not shown on the map. Figure 2 shows all but two of the other projects. The regional headings are given for cross referencing with other divisions' work, but the regions are not shown in figure 2.

#### STATEWIDE

Project Title: Alaska National Interest Lands Conservation Act Maps - Boundary Series

Chief: Roy E. Fordham

Objectives: To provide a series of boundary maps to meet requirements mandated in Public Law 96-487, the Alaska National Interest Lands Conservation Act.

Status: Map series numbered 2 through 31 are complete and printed. Series number 1 is to be printed in FY 1982. Cost estimates have been provided for series numbers 33 through 36.

Project Title: Alaska Orthophoto Products

Chiefs: John D. McLaurin and Roy E. Fordham

Objectives: To provide orthophoto products by full stereo-model at a scale of 1:31,680 for areas prioritized by the Bureau of Land Management. This program and the State of Alaska cost-share orthophotoquad program are intended to be mutually compatible. The individual models provided here will be used in producing full quadrangles for the State program.

Status: In FY 1982, the nine project areas originally scaled by simple rectification will now be differentially scanned and expanded to provide full township area coverage. The 12 new groups begun in FY 1981 will also be completed.

Project Title: Alaska Orthophotoquads

Chiefs: John D. McLaurin, Roy E. Fordham, and John R. Swinnerton

Objectives: To provide 1:63,360-scale orthophotoquad coverage in areas whose priority is designated by the State. This is a pilot program being accomplished under a joint funding agreement with the State of Alaska.

Status: Existing geodetic control and photography availability is being evaluated for the highest

priority requests outlined by the State. The FY 1982 program will consist of approximately 112 quadrangles. The future of a program for the remainder of the State will be decided after the pilot program is evaluated.

Project Title: Alaska Map E

Chief: John D. McLaurin

Objectives: To provide a limited revision at a scale of 1:2,500,000 to include new legislative boundaries described in Public Law 96-487, the Alaska National Interest Lands Conservation Act.

Status: Work will proceed when boundary information, including legal description, is complete.

Project Title: Alaska National Interest Lands Conservation Act 1:250,000-scale Revision

Chief: John D. McLaurin

Objectives: Provide limited revision for 1:250,000-scale maps in support of the implementation of the Alaska National Interest Lands Conservation Act.

Status: Thirty-one quadrangles have been selected as high priority areas for possible work in FY 1982. One map has already been sent to publication, and six more are in progress.

## NORTHERN REGION

Project Title: Arctic Alaska Landsat Land-Cover Mapping

Chief: Leonard Gaydos

Objectives: To produce vegetation land-cover maps and digital data using Landsat analysis techniques in arctic Alaska with the cooperation of interested agencies. Mapping is proceeding in three regions: the National Petroleum Reserve (NPR), Prudhoe Bay and the Dalton Highway corridor, and the Arctic National Wildlife Refuge.

Status: Final products from mapping land cover and vegetation using Landsat digital data for NPR are being used and evaluated by the Bureau of Land Management. Geological Survey Open-File Report 81-0315 describes the results of the mapping in NPR.

Work continues in finalizing data for the Beechey Point quadrangle and in comparing manuscript maps with those produced by the National Wetland Inventory.

Map I-1443, with 12 classes of vegetation and land cover, is being prepared for the Arctic National Wildlife Refuge Environmental Impact Statement for the coastal plain. The scale is 1:250,000. This classification is being extended to cover additional areas in the refuge.

Descriptions of the vegetation mapped in each of these areas have been compiled and compared with

several classification systems in use in Alaska.

Digital vegetation and land-cover maps of NPR, the Dalton Highway, and Arctic National Wildlife Range -- originally prepared for Environmental Assessments -- are being adapted for issue as interim quadrangle maps at 1:250,000 scale in the nationwide land-use and land-cover L-series.

Project Title: Tikikluk Orthophotoquads

Chief: Roy E. Fordham

Objectives: To provide 1:63,360-scale orthophotoquads in a 12-quadrangle area of the North Slope and gas fields near Point Barrow.

Status: The orthophotoquads were completed in mid-1981 and are now available as open-file material at the Rocky Mountain Mapping Center, Denver, Colo.

Project Title: National Petroleum Reserve in Alaska

Chiefs: John D. McLaurin and Roy E. Fordham

Objective: To provide 1:63,360-scale maps for that part of the National Petroleum Reserve in Alaska presently mapped only at a scale of 1:250,000.

Status: The project consists of 82 quadrangles originally compiled at a scale of 1:50,000 with metric contours. Advance manuscript copy is available for the complete project area and may be ordered from the Rocky Mountain Mapping Center. Map-finishing operations that will convert the sheets to 1:63,360-scale for publication have been started.

Project Title: Coal Resources Area, Northern Alaska

Chiefs: Roy E. Fordham and John D. McLaurin

Objective: To provide 1:63,360-scale maps of an area presently mapped only at 1:250,000 scale.

Status: The project consists of 45 quadrangles to be mapped at 1:63,360-scale with metric contours. Aerotriangulation is complete for 36 of the quadrangles. Stereocompilation is completed for six quadrangles and will continue during FY 1982. Photographic coverage is not available for nine of the remaining quadrangles.

Project Title: Demarcation Point

Chief: John D. McLaurin

Objective: To provide eleven 1:63,360-scale maps of an area previously unmapped at this scale.

Status: Advance manuscript copy is available and may be ordered from the Rocky Mountain Mapping Center. Map-finishing operations are in progress.

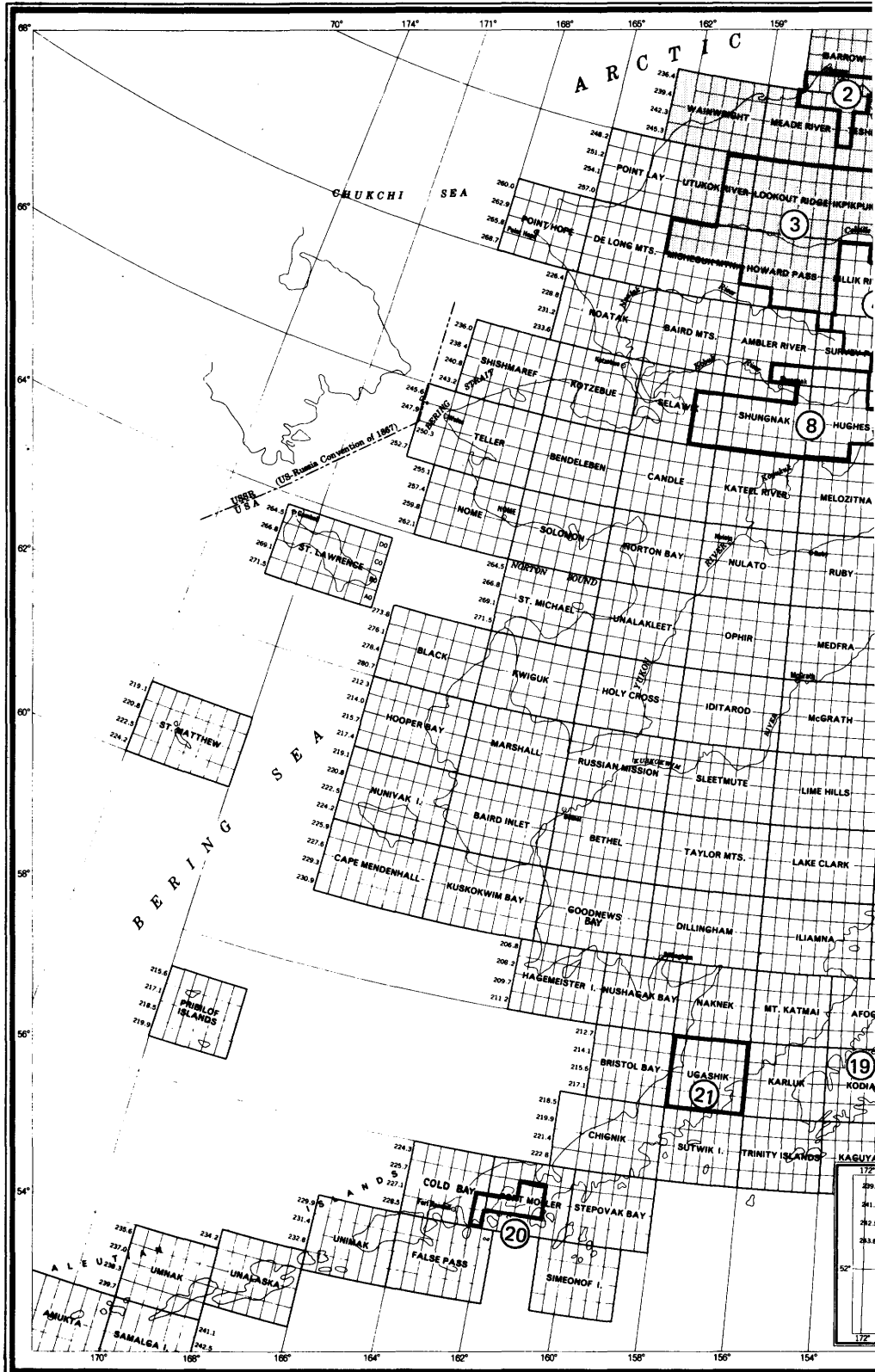
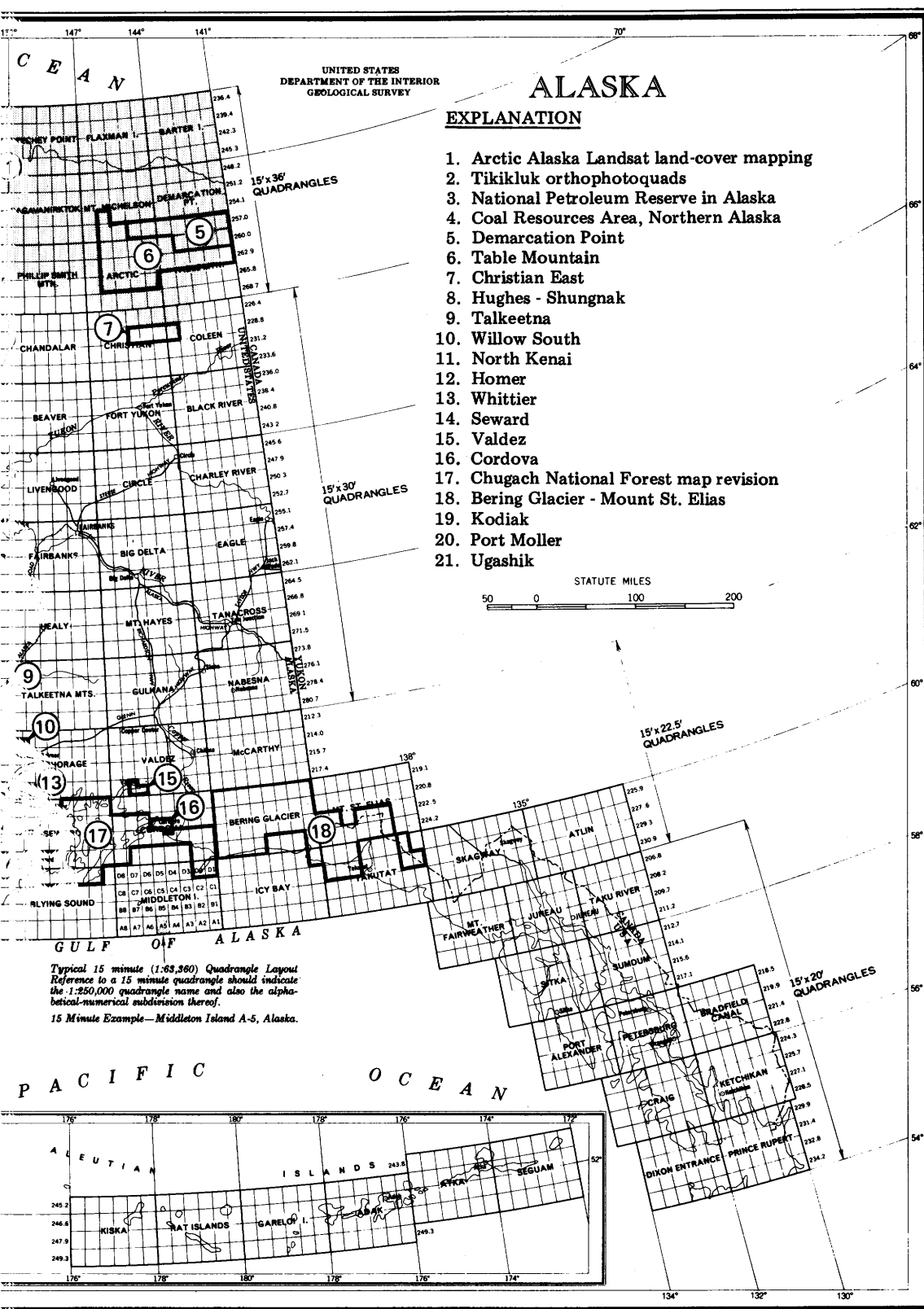


Figure 2.--National Mapping Divi



## ALASKA MAPPING

Project Title: Table Mountain

Chief: John D. McLaurin

Objective: To provide thirty-eight 1:63,360-scale maps of an area previously unmapped at this scale.

Status: Maps for 17 quadrangles have been published. Of the 21 quadrangles remaining in this area, two are compiled and advance manuscript copy is available from the Rocky Mountain Mapping Center, and 19 quadrangles are presently being compiled.

### WEST-CENTRAL REGION

Project Title: Hughes - Shungnak

Chief: John D. McLaurin

Objective: To provide 1:63,360-scale maps of an area previously mapped only at the 1:250,000 scale.

Status: The project area consists of 50 quadrangles that will be mapped with metric contours. Aerotriangulation has been completed, and compilation of 46 quadrangles is scheduled for contract completion during FY 1982. The remaining four quadrangles will be compiled at the Eastern Mapping Center.

### EAST-CENTRAL REGION

Project Title: Christian East

Chief: John D. McLaurin

Objective: To provide 1:63,360-scale maps of an area previously unmapped at this scale.

Status: Map finishing operations of the four quadrangles in this area are scheduled for completion in FY 1982.

### SOUTHERN REGION

Project Title: Talkeetna

Chief: John D. McLaurin

Objective: To satisfy the first priority request of the Alaska State Mapping Advisory Committee for 1:25,000-scale mapping.

Status: The project consists of eight 1:25,000-scale maps with metric contours. Mapping photography was flown in 1981, and field operations will commence in FY 1982.

Project Title: Willow South

Chief: John D. McLaurin

Objectives: To provide large-scale maps of the new State capital site near Willow.

Status: The project consists of four 1:25,000-scale maps with metric contours. Advance manuscript

copy is available and may be ordered from the Rocky Mountain Mapping Center.

Project Title: North Kenai

Chief: John D. McLaurin

Objective: To provide 41 large-scale maps for an area that covers the towns of Kenai and Soldotna, the industrial complex north of Kenai, areas along Sterling Highway in the National Moose Range, and recreation areas.

Status: Geodetic computations of the field surveys are complete for the 41 quadrangles in the project area, and map compilation at 1:25,000-scale with metric contours will follow.

Project Title: Homer

Chief: John D. McLaurin

Objective: To provide large-scale maps with metric contours for the part of the southern end of the Kenai Peninsula including the towns of Homer and Seldovia.

Status: Horizontal and vertical control necessary for compilation of the twenty-seven 1:25,000-scale maps in the project area is complete. Classification will be completed in the summer of 1982. Geodetic computations of the field surveys are in progress, and map compilation at a scale of 1:25,000 and with metric contours will follow.

Project Title: Whittier

Chief: John D. McLaurin

Objective: To provide large-scale maps of Whittier, Portage, and the Turnagain Arm area south of Anchorage.

Status: The project consists of seven 1:25,000-scale quadrangles with metric contours. Aerotriangulation is complete, and the maps are scheduled to be compiled during FY 1982.

Project Title: Seward

Chief: John D. McLaurin

Objective: To provide large-scale maps of the Seward area and vicinity.

Status: The project consists of six 1:25,000-scale quadrangles with metric contours. Five quadrangles are available in advance manuscript form and may be ordered from the Rocky Mountain Mapping Center. The remaining quadrangle will be compiled in FY 1982.

Project Title: Valdez

Chief: John D. McLaurin

Objective: To provide large-scale maps for the city of Valdez and the surrounding area.

Status: The project consists of five 1:25,000-scale maps with metric contours. Compilation is complete, and the map-finishing operations are scheduled for FY 1982-83.

Project Title: Cordova

Chief: John D. McLaurin

Objective: To provide large-scale maps of the town of Cordova and vicinity.

Status: The project consists of four 1:25,000-scale quadrangles with metric contours. These quadrangles have been compiled, and advance copy of the compilation manuscripts is available. Map-finishing operations have been started; completion is expected in FY 1983.

Project Title: Chugach National Forest Map Revision

Chief: John D. McLaurin

Objective: To satisfy the first priority request of the U.S. Forest Service for revision of 36 quadrangles at a scale of 1:63,360.

Status: Work in this area is being deferred pending receipt of National Aeronautics and Space Administration photography.

Project Title: Bering Glacier - Mount St. Elias

Chief: John D. McLaurin

Objective: To provide 1:63,360-scale maps in an area previously unmapped at this scale.

Status: These two projects consist of 50 quadrangles at 1:63,360-scale. Five maps of areas along the coast of the Gulf of Alaska have been compiled and are available in advance manuscript copy. Compilation of the eight remaining quadrangles in the "A" and "D" rows of the Bering Glacier 1:250,000-scale quadrangles will be completed in FY 1982. The 37 quadrangles in the Mount St. Elias project area will be compiled under contract, with expected completion in FY 1982.

Project Title: Bering Glacier, McCarthy, and Valdez Land-Use Maps

Chief: John D. McLaurin

Objective: To prepare three Land-Use and Land-Cover maps at 1:250,000-scale.

Status: Preliminary reconnaissance has been completed, and the maps should be completed by the end of FY 1983. The quadrangles are shown on the figure but not identified as a discrete project.

Project Title: Alaska Topographic-Bathymetric Maps

Chief: John D. McLaurin

Objective: To provide 1:250,000-scale topographic-bathymetric maps of the Alaska Peninsula and Cook Inlet areas in support of the Bureau of Land Management's Outer Continental Shelf and other coastal zone studies.

Status: The project consists of sixteen 1:250,000-scale quadrangles to be prepared under the Geological Survey-National Oceanographic Survey (NOS) joint topographic-bathymetric mapping agreement. NOS plans to provide the bathymetric data for one remaining quadrangle, and the Survey plans to add these data to the topographic maps during FY 1982. Fifteen quadrangles have been shipped to NOS for completion of the bathymetric overlay and registration. The project's study area can be found on the figure, but it is not specifically identified there.

## SOUTHWESTERN REGION

Project Title: Kodiak

Chief: John D. McLaurin

Objective: To provide large-scale maps for the port and town of Kodiak.

Status: Attempts during 1980 and 1981 to acquire aerial photography for 12 quadrangles in the project area were not completely successful. Until problems with photography acquisition are solved, the horizontal and vertical geodetic control for the compilation of the 1:25,000-scale maps with metric contours must be deferred.

Project Title: Port Moller

Chief: John D. McLaurin

Objective: To provide eight 1:63,360-scale maps of the Port Moller area presently mapped only at a scale of 1:250,000.

Status: Advance copy of the compilation manuscripts is available for the eight quadrangles. Map-finishing operations are expected to be completed by FY 1983.

Project Title: Ugashik

Chief: Lee Bender

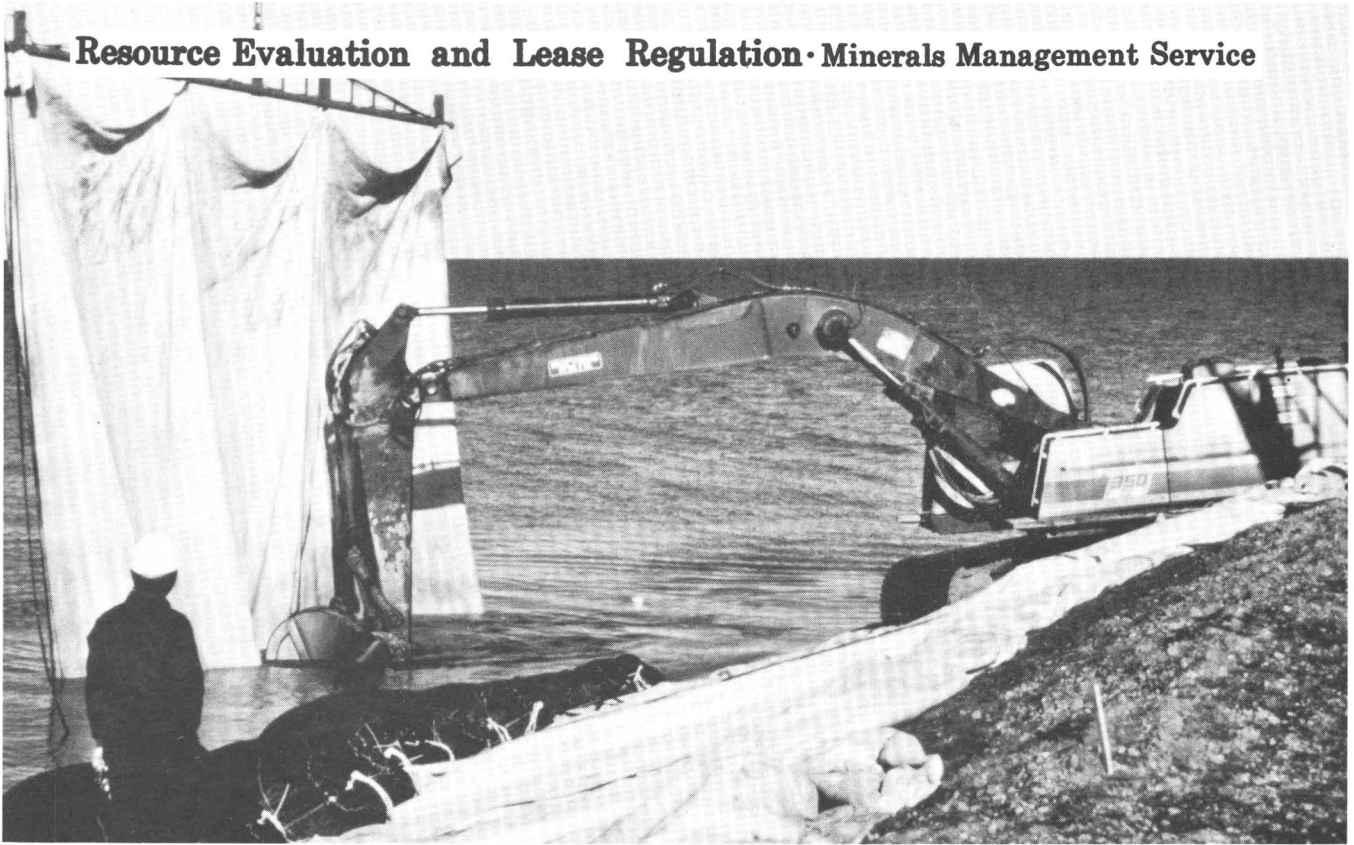
Objective: To develop a series of radar image maps at 1:250,000 scale by screenless lithography.

Status: The project consists of four radar image mosaics, two from the MARS real aperture system and two from the GEMS synthetic aperture system. Stereo strips are also included. Printing should be complete in summer 1982.





## Resource Evaluation and Lease Regulation • Minerals Management Service



Construction of a gravel island for offshore drilling; the hanging cloth is a filter that protects the island's sediment base from erosion. The Minerals Management Service oversees this kind of activity.

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# RESOURCE EVALUATION AND LEASE REGULATION

The recently established Minerals Management Service<sup>1</sup> examines and classifies Federal lands according to their mineral resources and waterpower or water-storage values, determines fair-market values of tracts offered for lease in competitive onshore and offshore sales, and supervises exploration and development for leases on the Outer Continental Shelf (OCS) and on Federal, Indian, and national petroleum reserve lands. In addition, the Service maintains accounts and collects rentals and royalties from petroleum production on Federal lands.

Consistent with national concern for environmental protection, the Service's regulations and procedures are frequently reappraised and revised to avoid or lessen consequences that may result from pollution incidents, surface damage from mining, geothermal, or petroleum operations, and other hazards that may be associated with activities conducted under leases or prospecting permits.

The Minerals Management Service performs the following functions in Alaska:

### Resource Evaluation

**Pre-Sale Reports.**-- Several years before lease sales, scheduled dates of which are shown in table 1, the Service acquires and interprets geological and geophysical data and then prepares reports and background material on lease sale areas (fig. 3; table 1). This work is closely coordinated with the Bureau of Land Management (BLM) and other Federal and State agencies. Geologic, exploration, and development reports are prepared in cooperation with the Survey's Geologic Division. These reports consist of information on the stratigraphy, structure, petroleum resource potential, environmental geology and geologic hazards, technology, time-frame, and infrastructure needed for exploration and development. This information is then made available to the BLM for incorporation into Environmental Impact Statements pertaining to OCS and onshore Planning Areas. The Department of the Interior selects sale areas based on the data from the geologic reports, other geologic and geophysical data that may exist at the time before the sale, and on industry interest.

### Resource Estimates

The Geologic Division estimates petroleum resources for geologic basins using volumetric yield methods. These estimates are revised periodically when new data become available. Before lease area selection, more refined estimates are made by the Deputy Minerals Managers (DMM's) for Offshore (ORE) and Onshore Resource Evaluation (ONRE). These estimates are further refined by detailed structural mapping and analysis as part of the evaluation process that continues right up to the lease sale date.

The DMM-ORE supervises the resource evaluation, mineral inventory, and classification of lands

for all leasable mineral commodities on Federal Outer Continental Shelf lands. Approximately 75 percent of the data interpreted by the Minerals Management Service are proprietary. In accordance with sections 8 (g) and 26 of the OCS Lands Act, the DMM-ORE cooperates with designated State officials to provide them access to proprietary data. The DMM-ORE provides for protection of proprietary data and for the timely release of nonproprietary data. Regional interpretations and sale-area-specific and tract-economic evaluations are also managed by the DMM-ORE who insures that the public receives fair-market value for oil and gas resources on the OCS.

Onshore Federal lands in Alaska are evaluated and classified for leasable minerals and geothermal energy resources by the DMM-ONRE. Leasable minerals in Alaska include oil and gas, coal, oil shale, and phosphate.

The ONRE organization in the Alaska Region was established as a separate entity in 1980 primarily to meet provisions in two recent acts: (1) the FY 1981 Interior Appropriations Bill, which included competitive oil and gas leasing in the National Petroleum Reserve in Alaska (NPRA), and (2) the Alaska National Interest Lands Conservation Act (ANILCA) that establishes an oil and gas leasing program in Alaska for all Federal lands south of the Brooks Range and North Slope lands east of NPRA. In addition to these Federal leasing programs, the ONRE organization prepares mineral reports for surface management agencies, including economic evaluation of tracts requiring a fair-market value determination for exchanges or conveyances.

**Geologic Hazards.**--High-resolution seismic data and shallow core hole data are used to delineate areas in proposed lease sale areas where geologic conditions are dangerous for man-made structures. These potential hazards are made known to the public so that mitigating measures can be taken during leasing, exploration, and production.

**Tract Evaluation.**--The Minerals Management Service makes detailed prospect and tract evaluations for each geologic structure in a sale area from all available geologic and geophysical data. Using a Monte Carlo Range of Values Program, a net present value is calculated for each tract. These values serve as a basis for accepting or rejecting bids for tracts during the lease sale.

### Regulatory Activities

The Minerals Management Service supervises and inspects oil and gas exploration and production operations on Federal lands to insure safety, prevent pollution, and assure environmental protection. These activities are carried out by personnel from the Deputy Minerals Manager-Offshore Field Operations and Onshore Field Operations (DMM-OFD and -ONFO) offices. Before activities may begin in a proposed operational area, all proposals, plans, and permits must be approved by the Minerals Management Service. In addition, environmental assessments are required that determine the potential for environmental impacts in the proposed operational areas. Special regulations have been developed for

<sup>1</sup>Formerly Conservation Division.

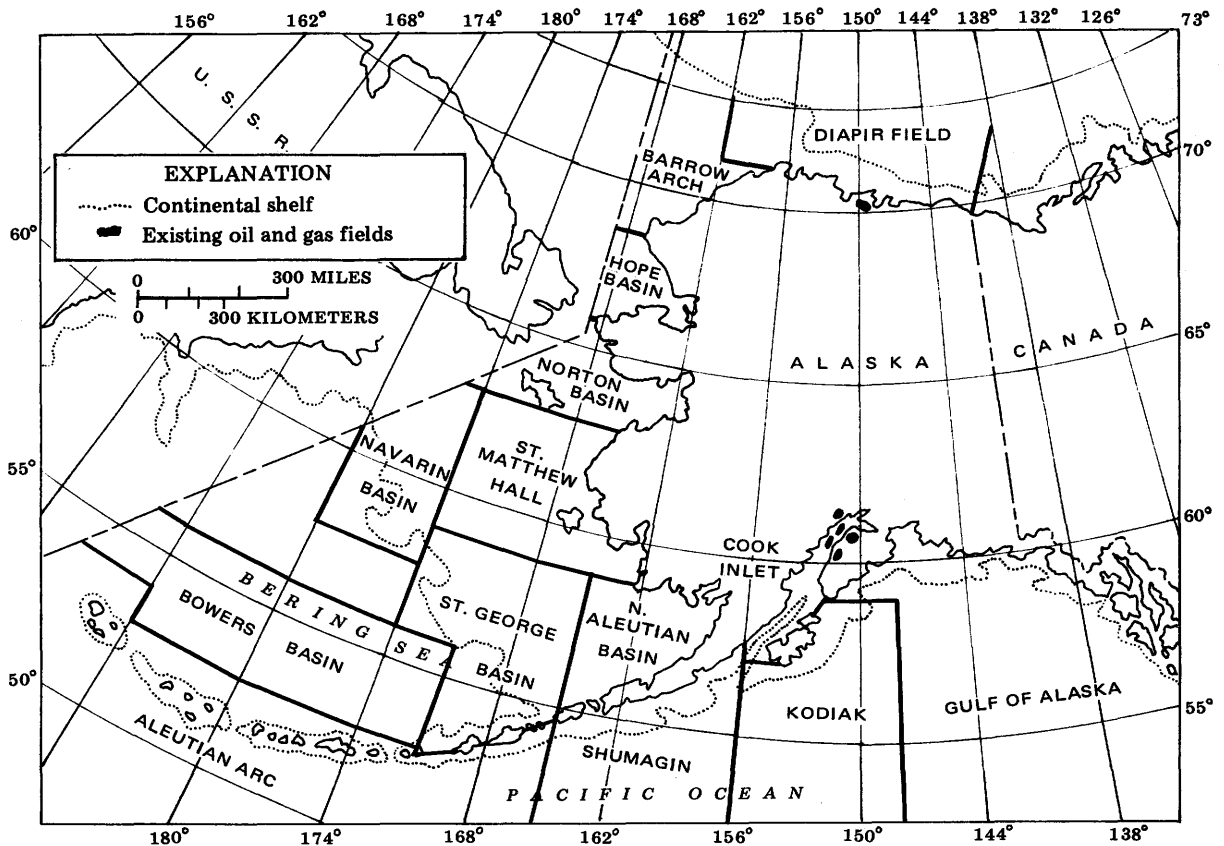


Figure 3. -- Location of Outer Continental Shelf basins.

Table 1. -- Oil and gas leasing schedule for onshore and offshore areas of Alaska.

	1981	1982	1983	1984	1985	1986
NAT'L PET. RES. - AK		S NS E	F NS			
60 - COOK INLET	F P GRNS					
71 - DIAPIR FIELD		E H F G NS				
57 - NORTON BASIN		F P GRNS				
70 - ST. GEORGE BASIN		H F P G NS				
75 - N. ALEUTIAN BASIN		E H F P G NS				
83 - NAVARIN BASIN	R I R	CD A	E H F P G NS			
87 - DIAPIR FIELD	R I R	CD A	E H F P G NS			
88 - NORTON BASIN	R I R	CD A	E H F P G NS			
89 - ST. GEORGE BASIN		R I R	CD A	E H F P G NS		
85 - BARROW ARCH		R I R	CD A	E H F P G NS		
92 - N. ALEUTIAN BASIN		R I R	CD A	E H F P G NS		
86 - HOPE BASIN			CD A	E H F P G NS		
100 - S. ALASKA *				CD A	E H F P G NS	
107 - NAVARIN BASIN				CD A	E H F P G NS	
97 - DIAPIR FIELD				CD A	E H F P G NS	
99 - NORTON BASIN					CD A	E H F P G NS
101 - ST. GEORGE BASIN					CD A	E H F P G NS
RS-2 REOFFERING SALE		P G NS				

C - Call for information D - Information due A - Area selection E - Draft environmental statement H - Public hearing F - Final environmental statement P - Proposed notice of sale G - Governor's comments due R - Energy review N - Notice of sale S - Sale RI - Request infrastructure IR - Infrastructure report due \*Includes Cook Inlet, Shumagin, Kodiak, Gulf of Alaska

## **MINERALS MANAGEMENT SERVICE**

Alaska and its environment, and Minerals Management Service geologists, geophysicists, petroleum engineers, and environmental experts review all exploration plans to insure compliance with these regulations.

On-site inspectors monitor each phase of exploration, development, and production. These inspectors are specially trained petroleum engineering technicians who are familiar with arctic conditions. During operational activities, the Service's environmental specialists enforce the restrictions of the lease stipulations for each exploration site. These restrictions are designed to minimize possible impacts.

Offshore activities.--At the present time, industry holds leases in three areas in the Alaskan OCS: the Gulf of Alaska, Lower Cook Inlet, and the Beaufort Sea. Seventeen additional lease sales are proposed for Alaskan waters in the next 5 years, and two sales are planned for 1987.

A gravel island drilling site was constructed on Beaufort Sea Lease Y-0191 about 15 miles north-east of Prudhoe Bay. Approval for the construction was obtained in February 1981 from the DMM-OFO for Alaska Region. Despite several arctic storms that halted work, Exxon, the designated operator, completed the island on April 9, 1981. Several kinds of instruments have been installed in the island to monitor temperatures, displacement, and settlement. Minerals Management Service personnel provided on-site monitoring throughout construction and will continue to monitor the island during drilling.

Drilling operations are taking place on Federally managed leases in the Beaufort Sea, and plans have been submitted to drill four deep stratigraphic test wells in the Bering Sea. With continued exploration on leases and with the number of new proposed sales, there will likely be an increase in exploration activity and an attendant increase in the regulatory responsibility of this office.

Onshore activities.--There are seven gas and three oil unit agreements in effect on Federal lands adjacent to Cook Inlet. All of the oil units and three of the gas units are producing at this time. In the oil fields and one of the gas fields, development drilling is currently underway and should continue for the next several years.

In January 1982, the BLM held a lease sale of 1.5 million acres of land on NPRA. This sale and others on NPRA are expected to generate exploration drilling; the sale is the first of the noncompetitive oil and gas leasing of other Federal lands in Alaska. The inspection requirements and other regulatory activities of the ONFO office will be increased accordingly.

### **Special Studies**

The Service has several special projects under way that will provide data for appraisal and regulation of Federal mineral and oil and gas resources. These projects include one geologic study to define

the extent of coal resources, four geologic studies to help define the petroleum reservoir and source-rock potential of basins, four paleontologic studies to support oil and gas exploration activities, and five geophysical and geotechnical studies to provide detailed environmental data on seafloor surficial geology and foundation conditions in future OCS lease sale areas. These projects are described in detail in the following section.

In addition, because of the Minerals Management Service's involvement with leasing activity in the area, the Minerals Management Service is assisting in the preparation of an Environmental Impact Statement on the oil and gas exploration regulations for the Arctic National Wildlife Refuge which is scheduled to be completed in August 1982.

## **PROJECTS OF THE MINERALS MANAGEMENT SERVICE**

### **NORTHERN REGION**

**Project Title:** Coal Resources of National Petroleum Reserve in Alaska (NPRA)

**Chief:** James E. Callahan

**Objectives:** To determine identified and hypothetical coal resources in western NPRA for use in land-use planning and to delineate areas suitable for leasing.

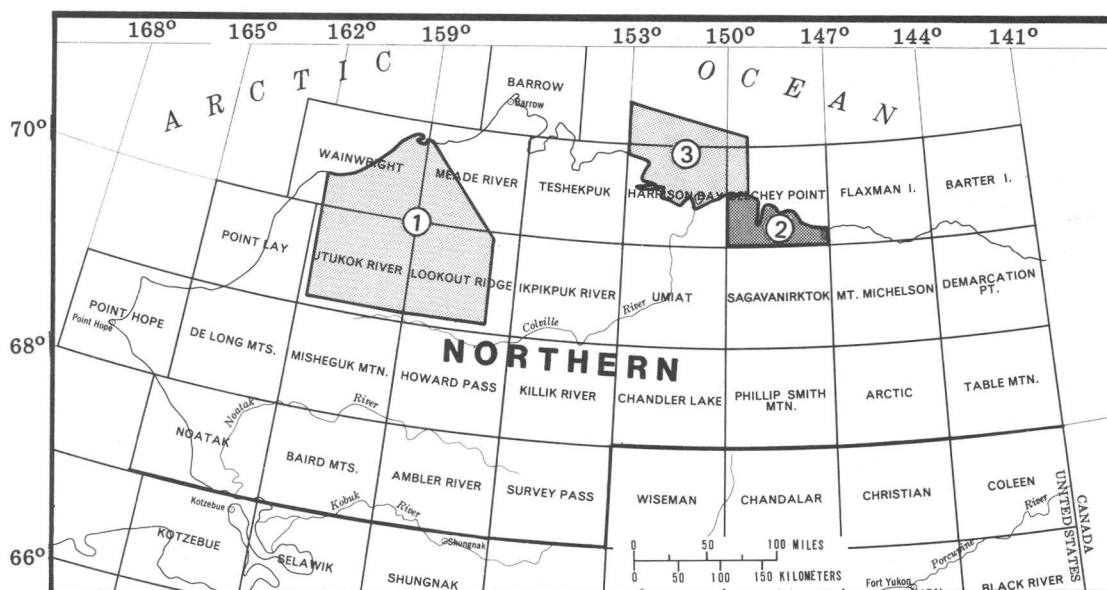
**Status:** The project is of an indefinite term and has been dependent in recent years on timing and location of oil and gas exploratory activity in the petroleum reserve. Data on coal bed thickness, quality, and distribution acquired from shot holes during the 1980 seismic program are being integrated with existing data for the Wainwright and Utukok River topographic quadrangles. An attempt is also being made to project surface and near-surface data into available seismic record sections for structural control and to provide approximate stratigraphic ties to coal zones logged in several coastal plain exploratory wells. The data acquisition phase of this project was terminated with completion of government oil and gas exploration in NPRA. Data will be compiled and analyzed as time permits, subject to higher priority work on evaluation of NPRA for oil and gas leasing.

The project location is shown in figure 4.

**Project Title:** Alaska Conodont Biostratigraphy and Thermal Maturity Study

**Chief:** John A. Larson

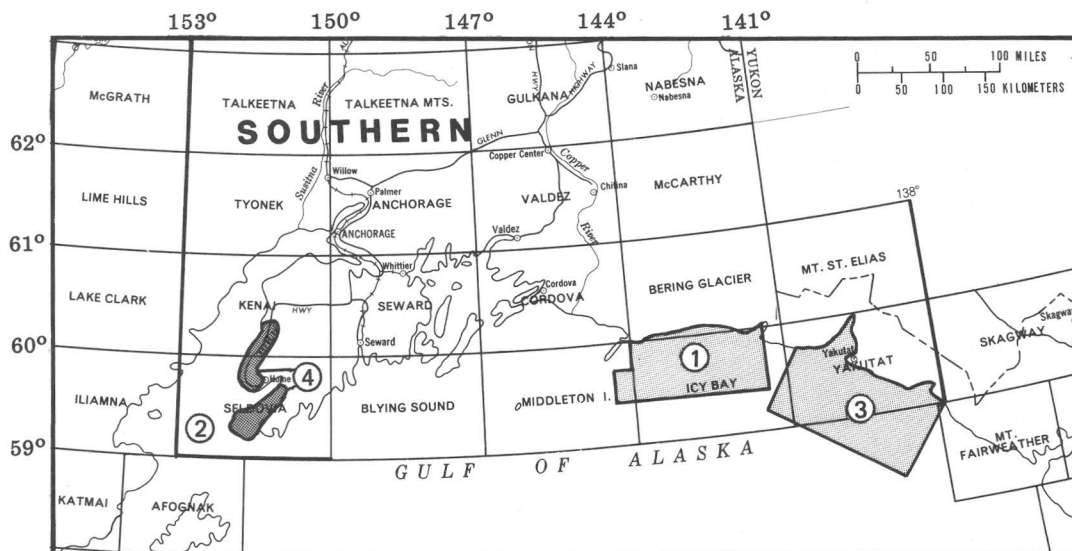
**Objectives:** To refine the biostratigraphy and establish thermal maturity of Paleozoic and Triassic rocks in potential oil-producing areas in and relating to the Alaska Outer Continental Shelf by processing well-cutting and outcrop samples and examining the conodonts. Conodont biostratigraphy has become well established in the conterminous United States, in Canada, and in Europe. Cono-



**EXPLANATION**

1. Coal Resources of National Petroleum Reserve in Alaska
2. Conodont Biostratigraphy and Thermal Maturity Study
3. Shallow Geology of the Beaufort Outer Continental Shelf

Figure 4. -- Minerals Management Service activities in northern Alaska.



**EXPLANATION**

1. Biostratigraphy and Paleoenvironments of the Outer Continental Shelf in the Sale 39 Area, Gulf of Alaska.
2. Lower Cook Inlet Basin Analysis
3. Shallow Geology of the Eastern Gulf of Alaska Outer Continental Shelf
4. Lower Cook Inlet Stratigraphic Study

Figure 5. -- Minerals Management Service activities in southern Alaska.

## MINERALS MANAGEMENT SERVICE

dont colors are accurate indicators of the thermal history of the enclosing rock. Potential targets for this study include the Shublik and older formations in the Prudhoe Bay area, the Brooks Range, and Cape Lisburne and the Triassic and (or) Paleozoic section from Continental Offshore Stratigraphic Test (COST) wells. The project will eventually be carried out statewide. Figure 4 shows the current study area, but some work is being done in the Goodnews Bay, Iliamna, Teller, and Seldovia quadrangles as well.

Status: The project is in early planning stages, and personnel are seeking to develop a program for sampling outcrops in the above-mentioned areas and to acquire from Prudhoe Bay area wells the large amount of well cuttings required for this research. Rock crushing equipment is needed. Expansion and refinement of existing lab facilities will have to precede acid processing of samples and subsequent heavy-liquid separation of residues that may contain conodonts.

The project location is shown in figure 4.

Project Title: Shallow Geology of the Beaufort Outer Continental Shelf

Chiefs: Glenn P. Thrasher and James D. Craig

Objectives: To identify geologic features and processes that might represent hazards or constraints to petroleum exploration in the area of Oil and Gas Lease Sale 71. Additional objectives are to locate potential sources of gravel for construction of offshore facilities and better to understand the subsea permafrost conditions in the area.

Status: High-resolution geophysical data were collected over Harrison Bay, about one-half of the sale area, during the summer of 1980. Data were also collected from previously drilled core holes to obtain stratigraphic and permafrost control. Project products will include maps showing bathymetry, shallow geology, environmental geology, and ice scour features.

The project location is shown in figure 4.

### SOUTHERN REGION

Project Title: Biostratigraphy and Paleoenvironments of the Outer Continental Shelf (OCS) in the Sale 39 Area, Gulf of Alaska

Chiefs: Ronald F. Turner and John A. Larson

Objectives: To make a detailed biostratigraphic, lithologic, and paleoenvironmental analysis of three Gulf of Alaska Outer Continental Shelf wells (Y-0007, Y-0032, and Y-0080) that penetrate through the glaciomarine Yakataga Formation in sale area 39. This analysis will involve recovery, identification, and analysis of microfossils such as foraminifers, diatoms, radiolarians, dinoflagellates, and nanoplankton from well samples, and examination of rock cuttings contained in the samples. Detailed biostratigraphic analysis of these wells will provide a correlation base for projection to and

comparison with wells drilled on tracts leased in the recent Gulf of Alaska OCS Sale 55 and with any subsequent wells on the Kodiak Shelf. Paleo-environmental analysis will provide an additional tool for locating the most favorable parts of the Gulf of Alaska OCS geologic section for petroleum source and reservoir rocks and for projecting the lateral trends of these rocks.

Status: This study is part of a larger, continuing project. Mud samples from three wells have been washed for recovery of foraminifers. Preliminary biostratigraphy based on foraminifers has been completed for wells Y-0007 and Y-0032; work on Y-0080 is nearing completion. Processing for other microfossil groups will be undertaken following upgrading and expansion of laboratory facilities. Study of siliceous microfossils is in abeyance.

The project location is shown in figure 5.

Project Title: Lower Cook Inlet Basin Analysis

Chiefs: John G. Bolm, John Larson, and Ronald F. Turner

Objectives: To integrate data from exploratory wells in lower Cook Inlet with seismic data and information from wells and outcrops in surrounding areas and to develop a regional framework for use in tract selection and evaluation for future oil and gas lease sales.

Status: Project work began in mid-1981. The comprehensive interpretive report will remain in-house until proprietary data used in the study have been released to the public.

The project location is shown in figure 5.

Project Title: Shallow Geology of the Eastern Gulf of Alaska Outer Continental Shelf

Chiefs: Bruce W. Turner and Glenn P. Thrasher

Objectives: To carry out investigations of surficial geology on the eastern Gulf of Alaska Outer Continental Shelf between Malaspina Glacier and Dry Bay. Of particular importance is the identification of geologic features and conditions that might represent hazards or constraints to petroleum exploration.

Status: During the summer of 1979, 5,580 line-kilometers of multisystem, high-resolution geophysical data was collected offshore on a rectangular grid between Malaspina Glacier and Dry Bay. Bathymetric, geologic, isopach, and geologic hazards maps are in review.

The project location is shown in figure 5.

Project Title: Lower Cook Inlet Stratigraphic Study

Chiefs: John G. Bolm and William M. Lyle (State of Alaska)

**Objectives:** To collect reservoir and source-rock data from outcrops of rocks along the east side of lower Cook Inlet for use in overall analysis of the basin.

**Status:** This is a cooperative project with the State of Alaska, Division of Geological and Geophysical Surveys. Fieldwork was completed during the summer of 1981, and a report describing the results of the project is being drafted.

The project location is shown in figure 5.

## WEST-CENTRAL REGION

**Project Title:** Shallow Geology of Norton Basin, Bering Sea

**Chiefs:** David A. Steffy and Peter J. Hoose

**Objectives:** To map the near-surface geology of the Norton Sound sedimentary basin and to identify and map features such as shallow gas accumulations, shallow or minor faults, and unstable sediments that may constitute hazards or constraints to petroleum exploration or development activities in the area of Oil and Gas Lease Sale 57.

**Status:** Data acquisition is complete. About 5,800 line-kilometers of multisystem seismic data has been collected, and interpretation began in January 1981. The following maps have been released to the open file: bathymetric map (81-0719), Holocene isopach map (81-0720), selected geologic features map (81-0721), acoustic anomalies and near-surface faulting map (81-0722), and an Upper Tertiary and Quaternary isopach map (81-0723).

The project location is shown in figure 6.

**Project Title:** Conodont Biostratigraphy and Thermal Maturity in the Minchumina Basin

**Chief:** John A. Larson

**Objectives:** To acquire conodont material from the Minchumina Basin area for biostratigraphic study and for evaluation of the thermal maturity as indicated by conodont color. The data will be useful in regional comparisons and analysis of biostratigraphy and thermal maturity of sedimentary basins in Federal onshore lease areas (National Petroleum Reserve in Alaska) and offshore areas (northern Aleutian Shelf, St. George Basin, and the like).

**Status:** This project is part of a joint Federal-State investigation of the stratigraphy and structure of the Minchumina Basin. Bulk samples to be processed for conodonts were collected in June 1981 from localities in the White Mountain, Limestone Mtn., and Lone Mountain areas in the Minchumina Basin. The study results will be offered for publication in the State Geological and Geophysical Surveys open-file series.

The project location is shown in figure 6.

## SOUTHWESTERN REGION

**Project Title:** Taxonomy, Ecology, and Bathymetric Distribution of Fossil and Recent Bryozoa, Kodiak Shelf, Gulf of Alaska

**Chief:** Ronald F. Turner

**Objectives:** To make detailed taxonomic and ecologic analysis of the fossil and modern fauna and flora of the Albatross Bank, Kodiak Shelf, with special emphasis on the bryozoans. Sediment type and distribution will be analyzed with reference to faunal distribution, source, and tectonic setting. The recent tectonic evolution of this area of the shelf will be interpreted using changes in bathymetrically sensitive components of the fauna and flora.

**Status:** Sampling, initial processing, and mapping have been completed; integration of seismic lines is incomplete. Work on this project is continuing.

The project location is shown in figure 7.

**Project Title:** Lower Cook Inlet-Shelikof Strait Field Project - 1981

**Chiefs:** Thomas N. Smith and George W. Petering

**Objectives:** To investigate potential reservoir and source rocks in upland areas adjacent to proposed Outer Continental Shelf sale areas in preparation for tract selection and block evaluations. To gather additional information on a quartz-rich sandstone of Upper Jurassic age.

**Status:** Open-File Report 81-0021, "Stratigraphic Sections, Hallo Bay to Katmai Bay, Shelikof Strait, Alaska, 1979", describes some of the project's results.

The project location is shown in figure 7.

**Project Title:** Shallow Geology of St. George Basin, Southern Bering Sea

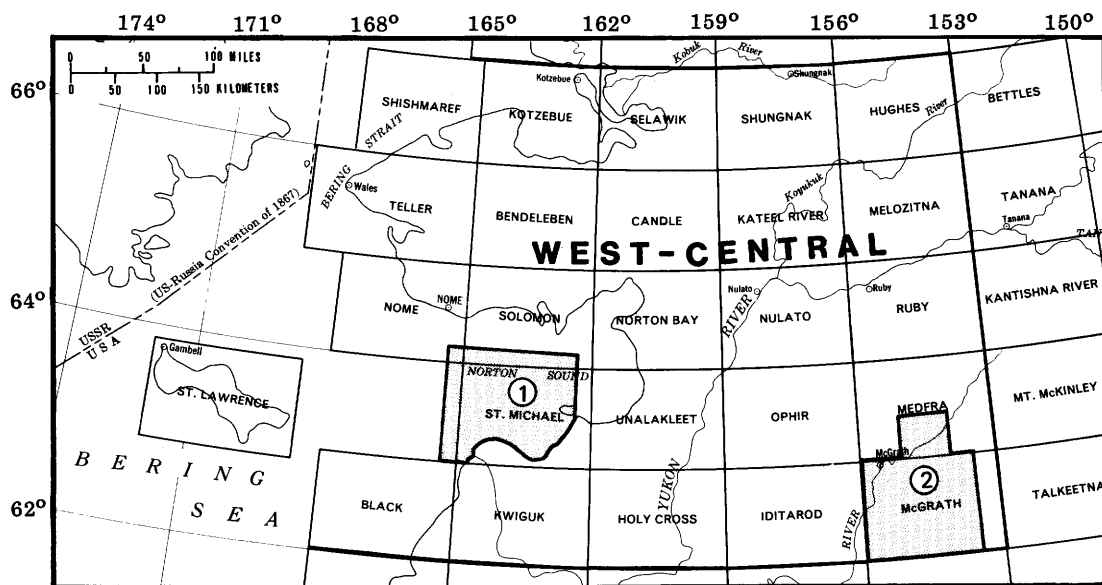
**Chief:** C. Drew Comer

**Objectives:** To map the near-surface geology of the St. George Basin and to identify features such as shallow faults, shallow gas accumulation, and unstable sediments that may constitute hazards or constraints to petroleum exploration or development activities in the area of Oil and Gas Lease Sale 70.

**Status:** High-resolution geophysical data collected in 1980 have been interpreted and merged with previously collected data. A bathymetric map has been completed and is undergoing technical review, an isopach map and a shallow structure map are near completion, and a map of geologic hazards is being prepared.

The project location is shown in figure 7.

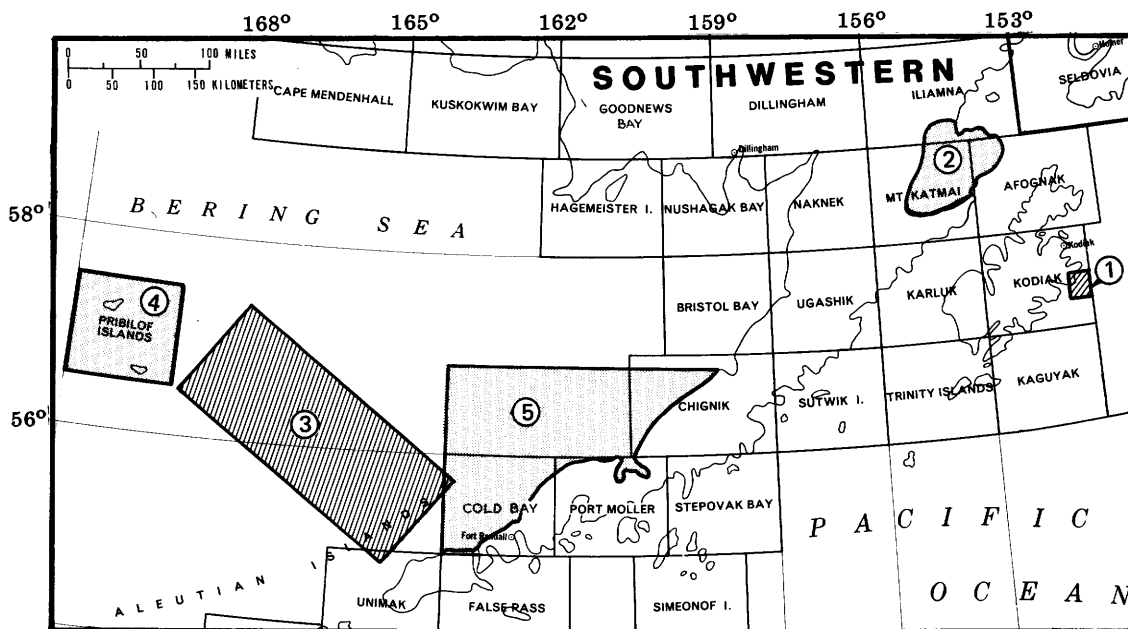
# MINERALS MANAGEMENT SERVICE



## EXPLANATION

1. Shallow Geology of Norton Basin, Bering Sea
2. Conodont Biostratigraphy and Thermal Maturity Study in the Minchumina Basin

Figure 6. -- Minerals Management Service activities in west-central Alaska.



## EXPLANATION

1. Taxonomy, Ecology and Bathymetric Distribution of Fossil and Recent Bryozoa, Kodiak Shelf, Gulf of Alaska
2. Lower Cook Inlet - Shelikof Strait Field Program
3. Shallow Geology of St. George Basin, Southern Bering Sea
4. St. George Basin Field Project
5. Shallow Geology of the Northern Aleutian Shelf, Bering Sea

Figure 7. -- Minerals Management Service activities in southwestern Alaska.



Project Title: St. George Basin Field Project

Chiefs: Thomas N. Smith and George W. Petering

Objective: To sample the Pribilof Island sedimentary rocks and assess their reservoir- and source-rock potential.

Status: Porosity and permeability data were collected in 1981. Petrographic analysis is underway.

The project location is shown in figure 5.

Project Title: Shallow Geology of the Northern Aleutian Shelf, Bering Sea

Chief: Peter J. Hoose

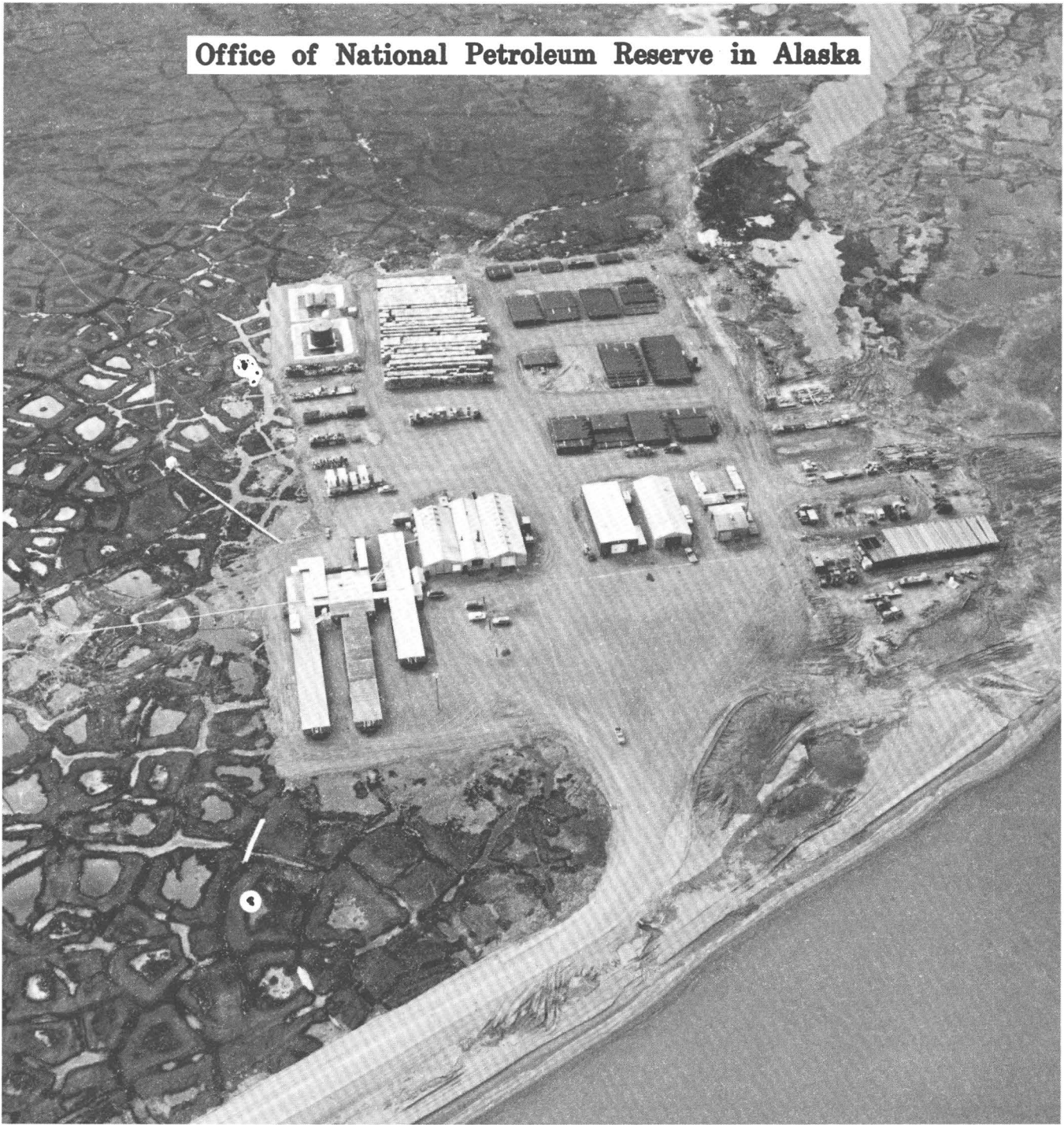
Objectives: To map the near-surface geologic environment of Bristol Bay and Amak Basins. Of particular importance is the identification of geologic features and conditions that might constitute hazards or constraints to hydrocarbon exploration in the areas of Oil and Gas Lease Sale 75.

Status: During the 1981 summer field season, approximately 4,000 line-kilometers of multisensored, high-resolution geophysical data were collected. Reproduced data arrived and interpretation began in the late fall of 1981. No fieldwork is planned for 1982.

Project location is shown in figure 7.



## Office of National Petroleum Reserve in Alaska



Camp Lonely

For further information, contact the offices listed below.

### Anchorage, Alaska

George Gryc, Chief; or

Max Brewer, Chief, Operations  
Office

Office of National Petroleum Reserve in Alaska  
2525 C Street, Suite 400  
Anchorage, AK 99503  
Tel. (907) 276-7422

## OFFICE OF THE NATIONAL PETROLEUM RESERVE IN ALASKA

During FY 1981, the U.S. Geological Survey completed the operational phase of the petroleum exploration on the National Petroleum Reserve in Alaska (NPRA) begun by the Navy in 1974. Responsibility for the exploration program on the Reserve was transferred from the Department of the Navy to the Department of the Interior on June 1, 1977, in accordance with the Naval Petroleum Reserves Act of 1976. The Geological Survey was assigned the responsibility of continuing the petroleum exploration program and other activities initiated by the Department of the Navy, namely to:

- \* Explore and evaluate the petroleum resources of NPRA by means of drilling and geological and geophysical investigations;
- \* Continue to develop and produce natural gas from the South Barrow gas field or other fields as may be necessary to supply gas at reasonable and equitable rates to the Native village of Barrow and other communities and Federal installations in the vicinity of Barrow; and
- \* Continue environmental rehabilitation of those areas of the Reserve disturbed by previous exploration activities.

In FY 1982, the Office of National Petroleum Reserve in Alaska (ONPRA) will be closed out, and all continuing responsibilities will be taken over by other offices, namely the Geologic Division and the Minerals Management Service (formerly the Conservation Division). During FY 1982, ONPRA will (1) complete the cleanup and rehabilitation of activity sites and return management to the Bureau of Land Management; (2) complete the public release of all technical information; (3) plan and contract for the continuation of operation of the Barrow gas fields; and (4) inventory and assign all technical files to other Geological Survey offices.

### HIGHLIGHTS OF THE FISCAL YEAR 1981 PROGRAM

During FY 1981, six exploration wells were completed. Since 1974, 28 wells (table 1, figure 8.) have been drilled, for a total of 283,877 feet of borehole, on 26 "structures". Husky Oil NPR Operations, Inc., continued as contractor for drilling in 1981. At the completion of drilling, all contractor equipment and the drilling rigs were demobilized from the Reserve, and all materials, equipment, and supplies were removed from the Reserve, surplus, or transferred to Barrow for use in operating and maintaining the Barrow gas fields. The base camp at Point Lonely was closed on December 6, 1981.

One geophysical party acquired 590-line miles of seismic data in 1981. The geophysical program was designed to study Cretaceous and Jurassic sandstones penetrated by the North Inigok and Walakpa wells. The seismic data were collected in areas of the Reserve where industry has expressed interest in early leasing on NPRA. Geophysical Services, Inc. was the contractor for field seismic data collection and processing, and Tetra Tech,

Inc. provided technical services, including interpretation of the seismic data.

The Geological Survey continued to operate the South Barrow gas field. Construction continued on surface facilities at the newer East Barrow gas field in preparation for production from five wells during winter of 1981-82.

Environmental rehabilitation activities continued on the Reserve. More than 380 tons of debris and waste materials from old construction and drilling sites was collected.

Data on wells finished in FY 1980 were released to the public. All geophysical data from 1974 through FY 1980 have also been released. Weekly summaries of drilling data and well logs were also made available to the public.

Details of these activities are given in the sections that follow.

### WELLS DRILLED IN FISCAL YEAR 1981

Awuna Test Well No. 1, at a site approximately 152 miles south-southwest of Barrow in the central part of the Reserve, was started on March 1, 1980, to test for potential oil and gas accumulations on one of the high structural positions on the prominent Carbon Creek-Awuna anticline, which extends across much of the Reserve. Specifically, the well was designed to test sandstones of the Torok and Fortress Mountain Formations of Cretaceous age. The well was suspended for the summer on May 8, 1980, at a depth of 5,300 feet before it penetrated the potential reservoir horizons. It was re-entered on December 5, 1980, and drilled to a total depth of 11,200 feet. The well was spudded in the Torok and reached the top of the Fortress Mountain at about 7,886 feet below land surface. (All depths reported herein are measured from land surface datum.) At that location the Torok is mostly shale with some thin, nonporous sandstones, many of which have gas shows. The upper part of the Fortress Mountain Formation includes more sandstone than the Torok, but the sandstones are fine grained, calcareous, and argillaceous, and generally have poor porosity. The mud logger recorded gas shows in many of the sandstones. A drill stem test near the top of the Fortress Mountain produced water at a rate of 2,057 (42-gallon) barrels a day. There is evidence of fracturing in some of the sandstones, and the high rate of water flow is probably due to fracture porosity. Minor amounts of asphaltic material occur in the lower part of the well. Very high pore pressures and lost circulation problems slowed the penetration rate, and drilling was terminated short of the projected total depth.

Walakpa Test Well No. 2, located 4 miles south-southwest of Walakpa Test Well No. 1, was drilled to a total depth of 4,360 feet and, following testing, was temporarily abandoned on February 15, 1981. The well was designed to test the Jurassic Simpson sandstone of local usage near its updip truncation and a Lower Cretaceous sandstone (the Walakpa sand of local usage); the latter tested gas in the Walakpa Test Well No. 1. The well was

spudded in the Torok Formation, which here consists mainly of shale with thin streaks of sandstone containing minor gas shows. Below the Torok Formation a normal sequence of the Lower Cretaceous pebble shale unit, Jurassic Kingak Shale, Triassic Sag River Sandstone, and shale, sandstone, and limestone beds of the Triassic Shublik Formation was penetrated. Drilling was terminated in argillite basement. The Lower Cretaceous Walakpa sand, found 536 feet deeper than in the Walakpa No. 1 well, was cored from 2,611 to 2,640 feet. The core recovered fine-grained, glauconitic sandstone with poor to good porosity and a show of hydrocarbons. A drill stem test of the sandstone recovered gas at a rate of 2.4 million cubic feet per day. The sandstone is 28 feet thick, compared to 16 feet in the Walakpa No. 1 well, and established a minimum gas column of 550 feet. The Simpson interval is siltstone, as in the Walakpa No. 1 well.

North Inigok Test Well No. 1 was spudded on February 13, 1981, and completed on April 4, 1981. It is situated 20 miles north-northeast of the Inigok No. 1 well. It was drilled to a total depth of 10,170 feet and bottomed in the Triassic Shublik Formation as a dry hole. Seismic records indicate an anomaly at the Upper Jurassic "C" datum level, which was interpreted as an offshore bar. The test well spudded in Tertiary (Paleocene) beds, then penetrated the Cretaceous Colville Group, Nanushuk Group, the Torok Formation, and the pebble shale unit. No sandstones were found in the Jurassic section, although a silty zone, perhaps representing the seismic anomaly, extends from 8,145 to about 8,400 feet. A thin siltstone in the Triassic Sag River Sandstone was drilled, and the well reached its total depth in the Shublik Formation. The wellsite geologist logged gas shows in the lowermost part of Torok Formation, and a single show was indicated in the Jurassic siltstone. A drill stem test of the latter zone produced gas at an estimated rate of 30,000 cubic feet per day and recovered 310 feet of gas-cut mud. The gas consisted of 73 percent methane, 12.8 percent ethane, 7.3 percent propane, 3.2 percent butane, and 3.7 percent pentanes and heavier hydrocarbons. Such an analysis implies the possible presence of an oil column down-dip and suggests reservoirs may be found in the Jurassic Kingak Shale elsewhere.

Kuyanak Test Well No. 1 was spudded on February 13, 1981, and completed on March 31, 1981, at a total depth of 6,690 feet. It is located 22 miles southeast of Walakpa No. 2. The well was drilled to explore primarily for the Simpson sandstone of local usage in the Jurassic Kingak Shale. This sandstone has good reservoir characteristics and occurs in wells to the southeast, south, and southwest of the Kuyanak test well. It is best developed in the Kugrua No. 1 test well, and subsurface controls indicate that similar conditions could be expected at the Kuyanak location. A trap was postulated because of the truncation of the sandstone on the Barrow Arch by the Early Cretaceous unconformity and by a facies change to the northwest. A secondary objective was the Sag River Sandstone of Triassic age. Drilling was begun in the Cretaceous Nanushuk Group, and a normal sequence of Cretaceous Torok Formation and

pebble shale unit, Jurassic Kingak Shale, Triassic Sag River Sandstone, and Shublik Formation was penetrated before drilling was terminated in the argillite basement. A sandstone correlated with the Walakpa sand of local usage was found at 5,092 feet and cored from 5,093 to 5,186 feet; it is more than 2,500 feet structurally lower at this site than at the Walakpa No. 2 well. There were no hydrocarbon shows in the sand, but core analyses show that porosity ranges from 15 to 22 percent and permeabilities are as high as 318 millidarcys. These results indicate a possibly continuous "sand" with good reservoir characteristics below a proven gas column. A Simpson sandstone equivalent occurs in the Kuyanak well from 5,378 to 5,656 feet; it consists mostly of siltstone and has minor gas shows near the top. The Simpson sandstone play lies to the south of this well. Equivalents of the Jurassic Barrow sand of local usage and Triassic Sag River Sandstone of the East Barrow field were cored; the latter indicated a minor gas show.

Tulageak Test Well No. 1, on the Beaufort Sea coast 24 miles east-southeast of Barrow, was spudded on February 26, 1981, and completed at a total depth of 4,015 feet on March 23, 1981. The well was drilled to test a combination structural-stratigraphic prospect. Detailed seismic studies indicate an east-trending graben north of the West Dease No. 1 well and separated from it by the Iko fault. Closure to the west is afforded by cross faulting and stratigraphic pinchout, whereas regional dip is maintained to the northeast. It was believed that Simpson level equivalents would be preserved in the structurally lower area. Four objectives were considered: the pebble shale unit - Walakpa sand, Simpson sand, Barrow sand, and Sag River Sandstone. The well was spudded in claystone of the Torok Formation and drilled mostly through shale with thin sandstones and some limestone streaks before reaching the pebble shale. The Early Cretaceous unconformity was indicated at approximately 2,950 feet. Below that point the Jurassic Kingak Shale, the Triassic Sag River Sandstone, and the Shublik sand and shale sequence was drilled until argillite basement was reached at 3,947 feet. Argillite was drilled and cored from this point to a depth of 4,015 feet. No sand was found in the pebble shale or at the Jurassic Simpson sandstone level. The Barrow sand is present, along with the Sag River Sandstone and several thin sandstones of the Shublik Formation. The Sag River Sandstone contained the only hydrocarbon show, and a drill stem test recovered slightly water-cut drilling mud with no evidence of hydrocarbons.

Koluktak Test Well No. 1, at a site 39 miles southwest of Inigok No. 1 well, was spudded on March 24, 1981, and completed as a dry hole on April 19, 1981, after reaching a total depth of 5,882 feet. The primary objective of the well was the sandstones of the Cretaceous Nanushuk Group, which had good gas and oil shows in several wells drilled under the Pet-4 program. Good reservoir conditions were indicated at the location on the east end of the Oumalik anticlinal trend. A low-velocity anomaly interpreted as a possible gas accumulation was also indicated by seismic records. The well penetrated a Nanushuk Group sequence from the

Table 2. -- Exploration wells drilled by the Navy from 1975 through 1977 and by the USGS from FY 1978 through FY 1981

Name	Location	Date Spudded	Date Completed	Total Depth	Deepest Horizon Attained	Remarks
Cape Halkett Number 1	18 mi ESE of Lonely	3/24/75	6/1/75	9,900 ft	Argillite basement (Devonian or older)	Dry; plugged and abandoned
East Teshekpuk Number 1	25 mi S of Lonely	3/12/76	5/11/76	10,664 ft	Granite basement	Dry; plugged and abandoned
South Harrison Bay Number 1	50 mi SE of Barrow	11/21/76	2/8/77	11,290 ft	Lisburne Group (Pennsylvanian part)	Poor oil shows; plugged and abandoned
Atigaru Point Number 1	44 mi SE of Lonely	1/12/77	3/18/77	11,535 ft	Argillite basement (Devonian or older)	Poor oil shows; plugged and abandoned
West Fish Creek Number 1	51 mi SE of Lonely	2/14/77	4/27/77	11,427 ft	Kayak Shale (Mississippian)	Poor oil shows; plugged and abandoned
South Simpson Number 1	41 mi WSW of Lonely	3/9/77	4/30/77	8,795 ft	Argillite basement (Devonian or older)	Dry; plugged and abandoned
W. T. Foran Number 1	23 mi ESE of Lonely	3/7/77	4/24/77	8,864 ft	Argillite basement (Devonian or older)	Oil and gas shows; plugged and abandoned
Drew Point Test Well Number 1	14 mi W of Lonely	1/13/78	3/13/78	7,946 ft	Argillite basement (Devonian or older)	Poor oil and gas shows; plugged and abandoned
South Meade Test Well Number 1	45 mi S of Barrow	2/7/78 (reentered 12/4/78)	1/22/79	9,945 ft	Argillite basement (Devonian or older)	Poor gas shows; plugged and abandoned
Kugrua Test Well Number 1	67 mi SW of Barrow	2/12/78	5/29/78	12,588 ft	Lisburne Group (Mississippian part)	Dry; plugged and abandoned
North Kalikpik Test Well Number 1	37 mi SE of Lonely	2/27/78	4/14/78	7,395 ft	Kingak Shale (Jurassic)	Poor oil and gas shows; plugged and abandoned
Inigok Test Well Number 1	60 mi S of Lonely	6/7/78	5/22/79	20,102 ft	Kekiktuk Conglomerate (Mississippian)	Encountered hydrogen sulfide and sulfur at 17,570 ft; poor gas shows; plugged and abandoned
Tunalik Test Well Number 1	22 mi SE of Icy Cape	11/10/78	1/7/80	20,335 ft	Lisburne Group (Pennsylvanian part)	Gas test; plugged and abandoned

Table 2. -- Continued

Name	Location	Date Spudded	Date Completed	Total Depth	Deepest Horizon Attained	Remarks
Ikpikpuk Test Well Number 1	42 mi SW of Lonely	11/28/78	2/28/80	15,481 ft	Kekiktuk Conglomerate (Mississippian)	Gas shows; plugged and abandoned
Peard Test Well Number 1	25 mi NE of Wainwright	1/26/79	4/13/79	10,225 ft	Argillite basement (Devonian or older)	Poor gas shows; plugged and abandoned
East Simpson Test Well Number 1	55 mi SE of Barrow	2/19/79	4/10/79	7,739 ft	Argillite basement (Devonian or older)	Oil and gas shows; plugged and abandoned
J.W. Dalton Test Well Number 1	3 mi E of Lonely	5/7/79	8/1/79	9,367 ft	Argillite basement (Devonian or older)	Oil and gas shows; some heavy oil recovered during testing; plugged and abandoned
Lisburn Test Well Number 1	110 mi SW Umiat	6/11/79	6/2/80	17,000 ft	Lisburne Group (Mississippian part)	Shows of gas; plugged and abandoned
Seabee Test Well Number 1	1 mi NW of Umiat	7/1/79	4/15/80	15,611 ft	"pebble shale" (Late Jurassic? and Early Cretaceous)	Oil and gas shows; plugged and abandoned
Walakpa Test Well Number 1	15 mi S of Barrow	12/25/79	2/7/80	3,666 ft	Argillite basement (Devonian or older)	Shows of gas; plugged and abandoned
East Simpson Test Well Number 2	50 mi SE of Barrow	1/29/80	3/15/80	7,505 ft	Argillite basement (Devonian or older)	Oil and gas shows; plugged and abandoned
West Dease Test Test Well Number 1	28 mi SE of Barrow	2/19/80	3/26/80	4,170 ft	Argillite basement (Devonian or older)	Oil and gas shows; plugged and abandoned
Awuna Test Well Number 1	152 mi S of Barrow	3/1/80 (reentered 12/5/80)	4/20/81	11,200 ft	Fortress Mountain Formation (Cretaceous)	Many gas shows; plugged and abandoned
Walakpa Test Well Number 2	16 mi S of Barrow	1/3/81	2/15/81	4,360 ft	Argillite basement (Devonian or older)	Temporarily abandoned (Gas well - Walakpa sand)
North Inigok Test Well Number 1	20 mi SE of Teshekpuk Lake	2/13/81	4/4/81	10,170 ft	Shublik Formation (Triassic)	Shows of gas; plugged and abandoned
Kuyanuk Test Well Number 1	30 mi SE of Barrow	2/18/81	3/31/81	6,690 ft	Argillite basement (Devonian or older)	Minor gas and oil shows; plugged and abandoned
Tulageak Test Well Number 1	24 mi ESE of Barrow	2/26/81	3/23/81	4,015 ft	Argillite basement (Devonian or older)	Few poor oil shows; plugged and abandoned
Koluktak Test Well Number 1	75 mi S of Smith Bay	3/24/81	4/19/81	5,882 ft	Torok Formation (Cretaceous)	Gas shows and minor oil shows; plugged and abandoned

surface to about 4,200 feet. The upper two-thirds of this section was predominantly sandstone but had thin shale, siltstone, limestone, and coal beds, many minor gas shows, and a few oil shows. The top of the Torok Formation was estimated to be at about 4,200 feet; from this point to total depth, shale with minor amounts of sandstone and siltstone was drilled. The imminence of spring break-up precluded any testing.

#### **BARROW AREA GAS ACTIVITIES**

No new gas wells were drilled during FY 1981. The Geological Survey continued to operate and maintain the South Barrow gas field, which supplies gas to the village of Barrow, as well as to Federal installations in that area. Construction continued on the production facilities at the newer East Barrow gas field, located approximately 7 miles southeast of the South Barrow gas field. New production will double the amount of natural gas available to the Barrow area.

#### **GEOPHYSICAL SURVEYS**

Geophysical studies on NPRA continued during FY 1981 with the acquisition, processing, and interpretation of 590 line-miles of seismic surveys in the eastern part of the Reserve. The purpose of the seismic work was to investigate the shallow Cretaceous sandstones, which are known to contain oil at Umiat, and deeper Jurassic sandstones penetrated by the North Inigok and Walakpa wells. The areas covered by the surveys coincided with areas of the Reserve where industry expressed interest in early leasing of NPRA. To date 13,455 line-miles of seismic data have been collected and processed.

#### **GEOLOGIC STUDIES**

In addition to the drilling and geophysical investigations, geologic and special studies were carried out by the Geological Survey and by contractors to support oil exploration activities. They include: geochemical studies to identify the type and amount of organic matter in rocks from wells and outcrops and to determine thermal history and source rock potential; studies of selected rock units in NPRA and adjacent areas to determine their depositional environment, structure, petroleum potential, reservoir properties, and stratigraphic relationships; field structural and stratigraphic studies to supplement well and seismic data and to resolve problems arising from interpretation of subsurface geologic and geophysical data; engineering geologic studies related to the source of construction materials for roads, airfields, and drilling pads, and hydrologic studies of the chemistry and controls of oilfield waters in NPRA and the effects of drilling on nearby lakes. These studies are being concluded, and the information is being made available to the public.

#### **ENVIRONMENTAL REHABILITATION**

The Geological Survey's environmental rehabilitation program on NPRA consists of two parts: the collection and consolidation of litter and debris left from earlier construction and oil exploration

activities, and the cleanup and revegetation of current drilling sites.

Early oil exploration and construction were carried out with little consideration for environmental protection or effects of drilling operations on the tundra. Fuel drums, abandoned equipment and supplies, and other litter of exploration and construction were left in place at many sites. During FY 1981 the Survey collected more than 380 tons of debris and waste materials, including 8,000 old barrels, from numerous sites on the Reserve. These materials were consolidated and stockpiled at several collection points on the Reserve.

Rehabilitation of current drill sites consists of an initial recontouring and revegetation, with a second reseeding during the following year. During FY 1981, initial rehabilitation work was done at six sites, and followup reseeding and fertilization was completed at other sites as necessary. Both cleanup and rehabilitation activities were accomplished by contract personnel.

#### **DATA AVAILABILITY**

Geologic and geophysical reports and well data from the drilling program are made available to the public through the Environmental Data and Information Service, National Oceanic and Atmospheric Administration, Boulder, Colo. 80303; tel. (303) 499-1000, ext. 6338. Core chips and ditch cuttings are provided through the Alaska Department of Natural Resources, Division of Oil and Gas Conservation, 3001 Porcupine Drive, Anchorage, Alaska 99501.

The NPRA exploration program has required many technical background studies in addition to the drilling and seismic operations carried out by the prime contractor, Husky Oil NPR Operations, Inc. In addition to the projects below, other current studies, being conducted primarily by the Geological Survey's Geologic Division, are described in this circular as part of each division's program in the northern region of the State.

For additional information about ONPRA activities, contact:

George Gryc, Chief, ONPRA, or  
Max Brewer, Chief, Operations Office, ONPRA  
2525 C Street, Suite 400  
Anchorage, AK 99503  
Tel. (907) 276-7422

### **PROJECTS OF THE OFFICE OF NATIONAL PETROLEUM RESERVE IN ALASKA**

Listed below are current projects of ONPRA. All project locations are included in the area shown in figure 8..

**Project Title:** National Petroleum Reserve in Alaska (NPRA) Data Open-File

**Chief:** (Please address questions about this project to George Gryc )



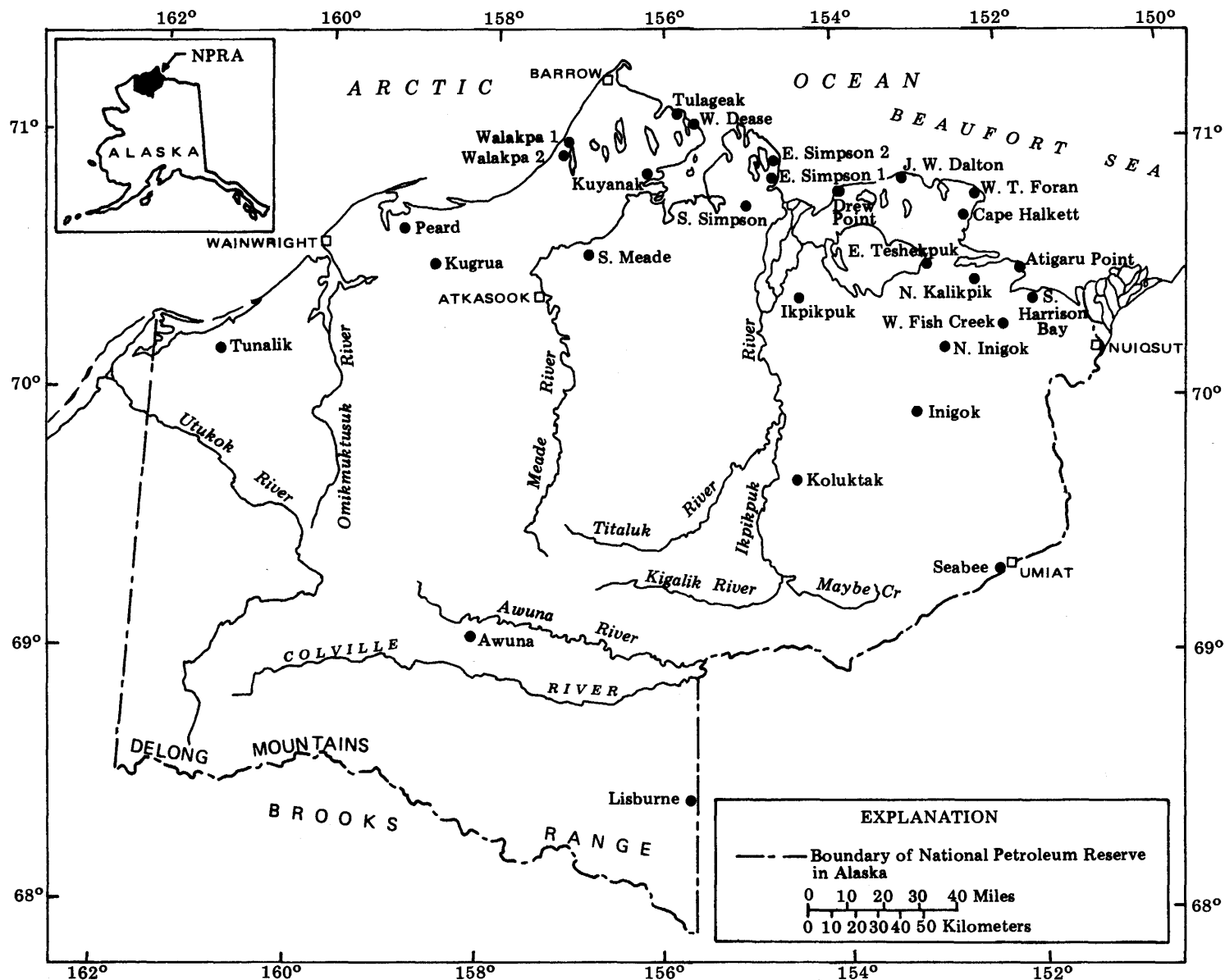


Figure 8. -- Exploration wells on the National Petroleum Reserve in Alaska, 1975-1981.

Objectives: To inventory, organize, and make available to the public all geological and geophysical data generated in the petroleum exploration of the NPRA by the U.S. Navy and by the Office of National Petroleum Reserve in Alaska.

Status: The exploration drilling and seismic survey programs on NPRA were terminated at the end of the 1980-81 winter season. All well and seismic information generated in that period has been released to the public through the National Oceanic and Atmospheric Administration (NOAA). A summary geologic report for FY 1980 activities, along with several topical geologic reports and special geophysical studies, have been released by NOAA. Final summary reports from the contractors and consultants will be released as they are received and approved by ONPRA. The first of these should be available in late 1982. NOAA has prepared a comprehensive catalog of the many data items provided to them by ONPRA, and interested data users should contact the Environmental Data Center in Boulder, Colo.

Project Title: Development and Operation of Gas Fields in the Barrow Area

Chief: Robert J. Lantz

Objectives: To operate and maintain the South Barrow and East Barrow gas fields through an Interagency Support Agreement with the Naval Arctic Research Laboratory at Barrow. These activities are undertaken in order to continue the supply of gas to the village of Barrow and to the Federal installations in the vicinity of Barrow.

Status: The Geological Survey continued to operate the South Barrow gas field. A gas production system was constructed at the newer East Barrow gas field to permit production of gas from this field beginning in early FY 1982. Two gas wells drilled in FY 1980 in the East Barrow gas field were com-

pleted as gas producers; one was suspended as a possible oil producer. No additional gas wells will be drilled in the Barrow area during FY 1982.

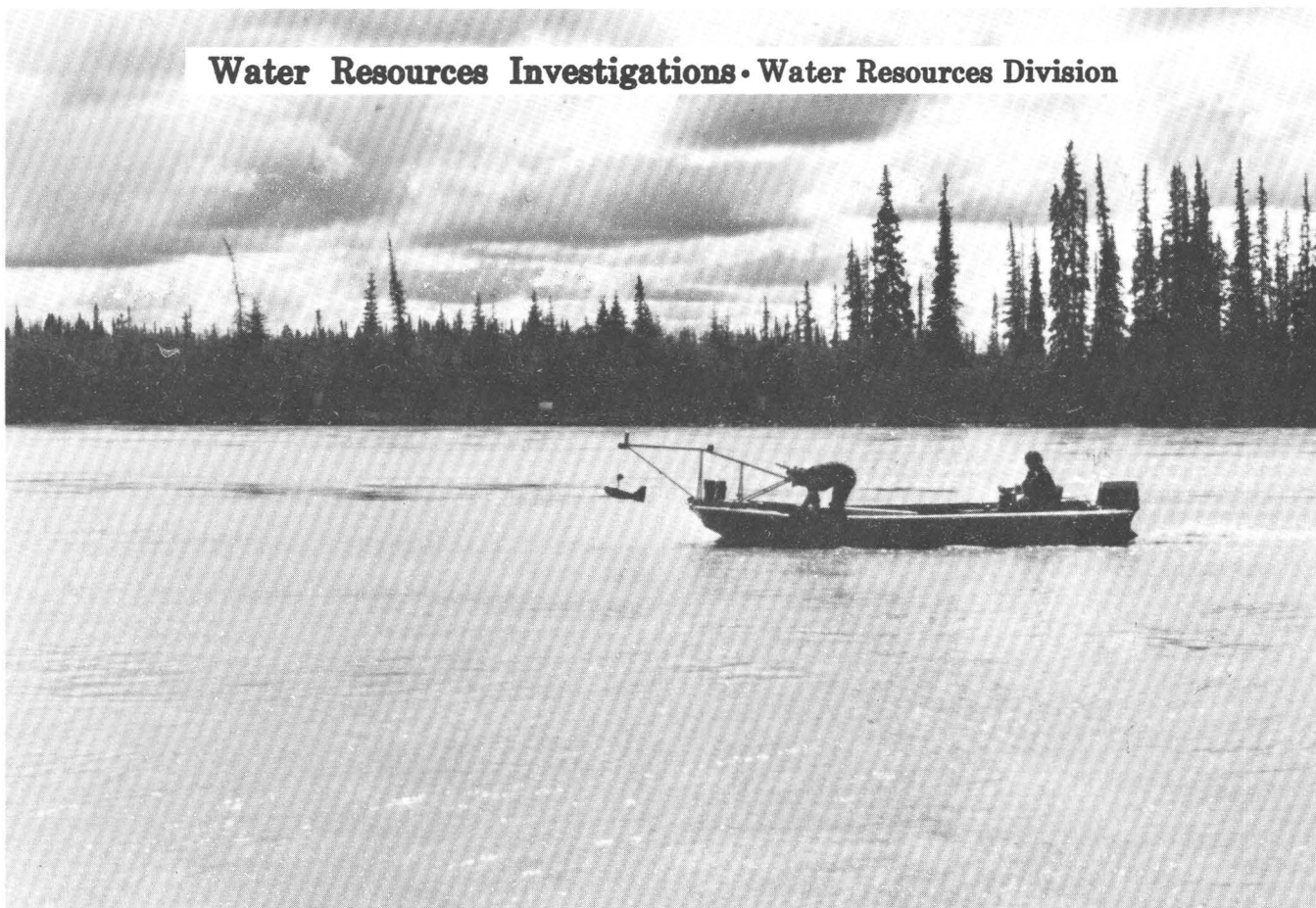
Project Title: National Petroleum Reserve in Alaska Paleontological Data

Chief: David C. Blanchard

Objectives: To date and correlate, by biostratigraphic methods, strata penetrated by the test field wells in NPRA; to make available to the public, by loan agreement, microscope slides of palynological and foraminiferal material; to describe micropaleontological material for reports based on well samples; to prepare plots of species diversity; and to complete a detailed study of the Lower Cretaceous section.

Status: Biostratigraphics Consulting Micropaleontology of San Diego, Calif., have processed and analyzed samples of well cuttings, cores, and sidewall cores provided by Husky Oil NPR Operations, Inc., drilling contractor for ONPRA, for five of the wells drilled during FY 1981. These are in addition to the wells analyzed previously by Anderson Worldwide Associates Micropaleontology Consultants of San Diego, Calif. Microfossil assemblages, including foraminifers and palynomorphs (dinoflagellates, acritarchs, pollen, spores), from 33 wells drilled between 1975 and 1981 have been analyzed with respect to their biostratigraphy and paleoecology. Reports on the microfossils and biostratigraphy distribution charts (paper copy and microfiche) for all wells can now be purchased from the National Oceanic and Atmospheric Administration (NOAA), Boulder, Colo. Survey Open-File Reports 80-193, 81-0013, and 81-1081 list all available palynomorph and foraminiferal microscope slides available, as well as details of the loan policy. Open-File Report 81-1165 discusses the biostratigraphic correlation of three lines of section (19 wells) across the Reserve. Paleontologic stage/zonule tops for all wells are listed and discussed in Open-File Report 81-1166.

## Water Resources Investigations • Water Resources Division



Suspended-sediment sampling in the Tanana River near Fairbanks.

For further information, contact the offices listed below.

### Anchorage, Alaska

Philip A. Emery

District Chief  
733 West 4th Avenue, Suite 400  
Anchorage, AK 99501  
Tel. (907) 271-4138

Larry Leveen

Chief, Anchorage Subdistrict  
1209 Orca Street  
Anchorage, AK 99501  
Tel. (907) 271-4153

### Fairbanks, Alaska

Bruce Parks

Chief, Fairbanks Subdistrict  
101 12th Avenue, Box 11  
Fairbanks, AK 99701  
Tel. (907) 456-0214

### Juneau, Alaska

Harold Seitz

Chief, Juneau Subdistrict  
P.O. Box 1508  
Juneau, AK 99802  
Tel. (907) 586-7216

### Menlo Park, California

John D. Bredehoeft

Regional Hydrologist  
Western Region  
345 Middlefield Road  
Menlo Park, CA 94025  
Tel. (415) 323-8111  
ext. 2337

### Reston, Virginia

Philip Cohen

Chief Hydrologist  
409 National Center  
Reston, VA 22092  
Tel. (703) 860-6921

### **WATER RESOURCES INVESTIGATIONS**

The water-resources program of the Geological Survey "has the objective of seeing that the Nation's water resources are appraised and that the necessary water data to develop and manage them efficiently are available when needed."<sup>1</sup> The Survey is the primary source of hydrologic data that are basic not only to quantification of water resources but also to their development and conservation, including data for both planning and management. This role, practiced for many years and tacitly accepted by the water-resource community, was given express recognition in 1964 when the responsibility for coordinating water-data programs of Federal agencies was delegated to the Geological Survey (Office of Management and Budget Circular A-67). For the past decade, largely in response to the growing public awareness of the environment, the Survey has provided data and technology needed to predict the impact of man's activities upon the water resource and the water environment.

The Geological Survey's Water Resources Division determines the source, quantity, quality, distribution, movement, and availability of surface and ground water. This work includes investigations of floods and potential sources of water supply in river basins and ground-water systems; determination of the chemical, biological, and physical quality of water resources and their relation to various parts of the hydrologic cycle; special hydrologic studies of the inter-relations between climate, topography, vegetation, soils, and the water supply; research to improve the scientific basis of investigations and techniques; scientific and technical assistance to other Federal agencies and to licensees of the Federal Energy Regulatory Commission; coordination of Federal water-data acquisition activities; design and operation of a national water-data network; and publication of results of investigations.

The Division's program in Alaska is divided into three broad categories. One category is hydrologic data collection to provide information about hydrologic characteristics essential to planning and carrying out hydrologic appraisals and/or hydrologic research. In 1982 this type of work constitutes the major part of the Division's efforts in Alaska. A second category is hydrologic appraisals. This includes analyses of conditions in hydrologic basins, studies of areas likely to be or being affected by mineral, energy, fisheries, coastal zone, or urban development, studies of water resources in urban areas, investigations of potential hydrologic hazards and environmental impacts of pipeline construction, and other cooperative studies. The third category consists of basic and applied research in hydrologic topics unique to cold climates. Subjects being studied include surface and ground water, water quality, instrumentation, glaciers, snow and ice, ice dynamics, and limnology.

In Alaska, the Water Resources Division operates through a district office and its three subdistrict offices, in Anchorage, Fairbanks, and

Juneau. Each of the subdistrict offices maintains files of data for a geographic area for which it is responsible. Site-specific information on water resources is available from the subdistrict office nearest the site in question. The District Office in Anchorage should be contacted for general information on statewide projects or activities.

Water-resources studies in Alaska are carried out in cooperation with a variety of Federal, State, and local agencies. These are identified in table 4.

### **NATIONAL PROGRAMS**

Alaska's water resource investigations are part of several national programs. These are described briefly below.

#### **COLLECTION OF BASIC RECORDS**

The Collection of Basic Records or CBR program in Alaska entails the operation of 120 river gaging stations, 70 crest-gage stations, and 31 observation wells. The data collected at these sites appear in the annual publication "Water Resources Data for Alaska." (In addition, about 80 wells are operated for short periods for specific projects.) The CBR program is described in more detail in the appropriate projects which follow this summary.

#### **NATIONAL STREAM QUALITY ACCOUNTING NETWORK (NASQAN)**

This is a data-collection program for obtaining regional and national overviews of the quality of our streams. Water-quality data from NASQAN stations provide the information needed to: (1) account for the quantity and quality of water moving within and from the United States; (2) develop a large-scale picture of how stream quality varies from place to place; and (3) detect changes in stream quality with time. At a NASQAN station a continuous record of stream stage is obtained, from which streamflow is computed. Most of these stations are also equipped with a recorder for obtaining continuous data on water temperature. The following data are collected approximately six times per year at each site: pH, bacteria, inorganic compounds, nutrients, suspended sediment, and floating algae. Samples are collected less frequently for trace-element and organic-carbon analysis.

In Alaska, the following NASQAN stations are currently in operation: Stikine River near Wrangell, Skagway River at Skagway, Copper River near Chitina, Susitna River near Susitna Station, Nushagak River at Ekwok, Kuskokwim River at Crooked Creek, Tanana River at Nenana, Yukon River near Pilot Station, and Kuparuk River near Deadhorse.

#### **NATIONAL WATER DATA EXCHANGE (NAWDEX)**

This is a national confederation of water-oriented organizations working together to improve access to water data. Its primary objective is to assist users of water data in the identification, location, and acquisition of needed data. For the users' convenience, NAWDEX services are available

<sup>1</sup>The Budget of the United States Government, Fiscal Year 1974, Appendix, p. 552.

through a nationwide network of local assistance centers. In Alaska, the NAWDEX assistance center is located in the District Office of the Water Resources Division, 733 West 4th Avenue, in Anchorage.

Through its master water-data exchange, NAWDEX provides a nationwide indexing service. This computerized index identifies more than 180,000 sites for which water data are available from over 300 organizations, the geographic location of these sites, the data-collecting organization, the types of data available, the periods of time for which the data are available, the major water parameters for which data are available, the frequency of measurements, and the media in which the data are stored. NAWDEX has direct access to the computerized data files of the U.S. Geological Survey's national water data storage and retrieval system, WATSTORE (which includes several types of files and indexes such as the Ground Water Site Inventory, or GWSI). NAWDEX is also an authorized user of the storage and retrieval (STORET) system of the U.S. Environmental Protection Agency.

### HYDROLOGIC RESEARCH

As part of its national program of hydrologic research, the Water Resources Division has for many years conducted fundamental investigations in Alaska on several aspects of arctic hydrology. Late in 1980 an important step toward the intensification of these studies was taken with the establishment of a Cold Regions Hydrology Project Office in Fairbanks. The Project Office carries out basic research in such topics as glacier dynamics and fluctuations and the interaction of glaciers and volcanoes. For information about this glacier research, contact Larry Mayo of the Fairbanks office of the division. Other project studies involve the relationships between permafrost and ground water, the formation of and hazards presented by river-ice jams, the chemistry and ecology of arctic lakes and streams, and erosion and sedimentation by arctic streams. In addition to new knowledge provided by these studies, which will be immediately applicable in a wide spectrum of investigations in the Geological Survey programs, the project staff will provide consultation and advice to staff of the Water Resources Division and to other elements of the Geological Survey and, through the Bureau, to other Federal and State agencies concerned with problems related to the hydrology of cold regions. For information about the Cold Regions Hydrology Project, contact John Conomos of the Division's Regional Office in Menlo Park, Calif.

## PROJECTS OF THE WATER RESOURCES DIVISION

### STATEWIDE

Project Title: Surface-Water Stations

Chief: Robert D. Lamke

Objectives: To provide data on (1) streamflow, (2) flood discharge and stages, and (3) lake stage through a network of gaging stations. This project

is part of an ongoing assessment of the Nation's water resources and is part of the Collection of Basic Records (CBR) program. The data are used in project design and planning of water-supply and waste-disposal systems, of stream crossings and hydroelectric facilities, and of bridges, and also are useful in the assessment of environmental impacts of these and other proposed activities.

Status: This is a continuing project; all data are published in the Survey's annual series "Water Resources Data for Alaska." The 1981 report is expected to be completed by July 1982. Discharge data will be published for 120 daily-record stations, 70 crest-stage gages, and 48 low-flow partial-record stations. The gaging-station network operated during 1982 will differ from that in 1981 because of program changes. There will be a decrease in the number of stations in southeast Alaska, and many of the stations along the Dalton Highway north of Fairbanks to Prudhoe Bay will be reactivated.

Project Title: Quality-of-Water Stations

Chief: Robert J. Madison

Objectives: To provide a national bank of water-quality data for broad Federal planning and action programs and management of interstate and international waters. To provide information on the physical and chemical properties of water by: (1) determining the mineral content and biological aspects of water, thereby establishing a baseline from which changes can be evaluated; and (2) determining mineral composition of water to evaluate its use for domestic, municipal, and industrial water supplies. These objectives are accomplished by operation of a network of water-quality stations. This project is part of the Collection of Basic Records (CBR) program.

Status: This is a continuing project; all data are released in the annual Geological Survey publication "Water Resources Data for Alaska."

Project Title: Sediment Stations

Chief: James M. Knott

Objectives: To provide a national bank of sediment data for broad Federal and State planning and action programs and for Federal management of interstate and international waters. This project is part of the Collection of Basic Records (CBR) program.

Status: Data collection is continuing for 9 NASQAN sites, 9 sites for the U.S. Forest Service, 2 stations for the Corps of Engineers, 1 benchmark station, and at 4 additional sites in the southeast, southcentral, and Yukon subregions. Each year's data are reported in the annual publication "Water Resources Data for Alaska."

Project Title: Alaska Water-Use Data Program

Chief: Leslie D. Patrick

## WATER RESOURCES

**Objectives:** To develop an orderly and systematic method to collect, store, and disseminate detailed water-use data for policy planning, budgeting, and management of Alaska's water resources. This system will support the National Water-Use Data System and Alaska's water rights program. The majority of the work will be completed by State personnel.

**Status:** The Alaska Department of Natural Resources, Division of Forest, Land, and Water Management has fully staffed the water-use component of the Water Management Section. Their water rights computer file is now operational and contains approximately 8,000 case files. In addition, a general design workplan for the more sophisticated water-use data base has been established. The State has published several documents, including: the "Project Management Plan", a public information brochure entitled "Alaska Water Use Data System", a "Statement of State Objectives and Statement of Rationale for the Alaska Program", the "State of Alaska Water User's Handbook", the "Alaska Water Meter Manual", "Water Use Information Coding and Entry to Easytrieve-Access Files", and "Personnel Requirements." A survey of seafood processors and agricultural water users was completed in FY 1981. The data collected will be compiled and entered into the new computer system when it is available. Hydroelectric, domestic, and public water supply water-use data have been entered into the National Water-Use Data System.

**Project Title:** Techniques of Hydrologic Assessment for Planning and Management in Alaska

**Chiefs:** Robert J. Madison and Bruce Parks

**Objectives:** To summarize available techniques that can be used with existing data bases or a minimum of simple field data collection to predict or estimate hydrologic parameters for planning purposes, and to evaluate the confidence levels of the various techniques and their applicability to Alaskan streams.

**Status:** This is the first full year of project work. Methodologies for estimating hydrologic parameters are being defined, and the data bases are being evaluated to determine confidence levels for the available methods. A report is in preparation.

**Project Title:** Ground-Water Stations

**Chief:** Gordon L. Nelson

**Objectives:** To maintain a network of observation wells to provide data on ground-water level fluctuations in Alaska. For selected aquifers, these data will indicate the status of ground water in storage, changes in levels due to development (pumping), probable effects of current or planned land use or water-supply development, and probable base flow of hydraulically connected streams nearby. The network will provide long-term records for regional studies that, in turn, serve as

a basis for correlation of short-term hydrologic records for specific purposes.

A related project began in 1982; the objective of that study is to develop a statewide observation-well network that will provide ground-water hydrographs in areas of significant demand for hydrologic information.

**Status:** This is a continuing long-term project. Water-level records collected at 31 federally funded Collection of Basic Records (CBR) wells will be published in the 1981 annual Survey report "Water Resources Data for Alaska." Data for other network wells are published infrequently in reports on specific water-resource studies.

The locations of ground-water observation wells are shown in figure 9.

**Project Title:** Water, Ice, and Energy Balance of Snow and Glaciers, and Snow and Ice Physics

**Chief:** Mark F. Meier

**Objectives:** To improve understanding of aspects of snow accumulation, melt, and runoff processes on glaciers and in high mountains, the mechanics of water flow through and under glaciers, and the dynamics of glaciers, and to apply this understanding to problems such as the nature of glacier surges and the stability of iceberg-calving glaciers.

**Status:** Research continues on Columbia Glacier, near Valdez, which is expected to begin rapid retreat perhaps as early as 1982. This retreat will cause increased iceberg discharge into Valdez Arm. In July and August 1981, heavy rains and the partial outbreak of a glacier-dammed lake caused high rates of iceberg calving, producing the greatest retreat yet observed. However, about 1 kilometer of the terminus is still in shallow water on a moraine shoal, and an irreversible retreat has not yet begun. Basic-data and modeling reports are in preparation, and research continues on the transient, dynamic response of this glacier.

A research team aboard the U.S. Geological Survey Research Vessel *Growler* collected data on the neoglacial advance and retreats of the glaciers in Icy Bay, near Yakutat, in August 1981. Information on bathymetry, subbottom profiles, stratigraphy, and botany was obtained. Reconnaissance air photography was continued; this work shows that both the Bering and Malaspina Glaciers, the two largest glaciers on mainland North America, were surging in September 1981.

Project location is shown in figure 10.

**Project Title:** Alaska Glaciology

**Chief:** Larry R. Mayo

**Objectives:** To analyze long-term climate and glacier data to detect significant changes; to discover cause-and-effect relationships and determine response characteristics of glacier-related

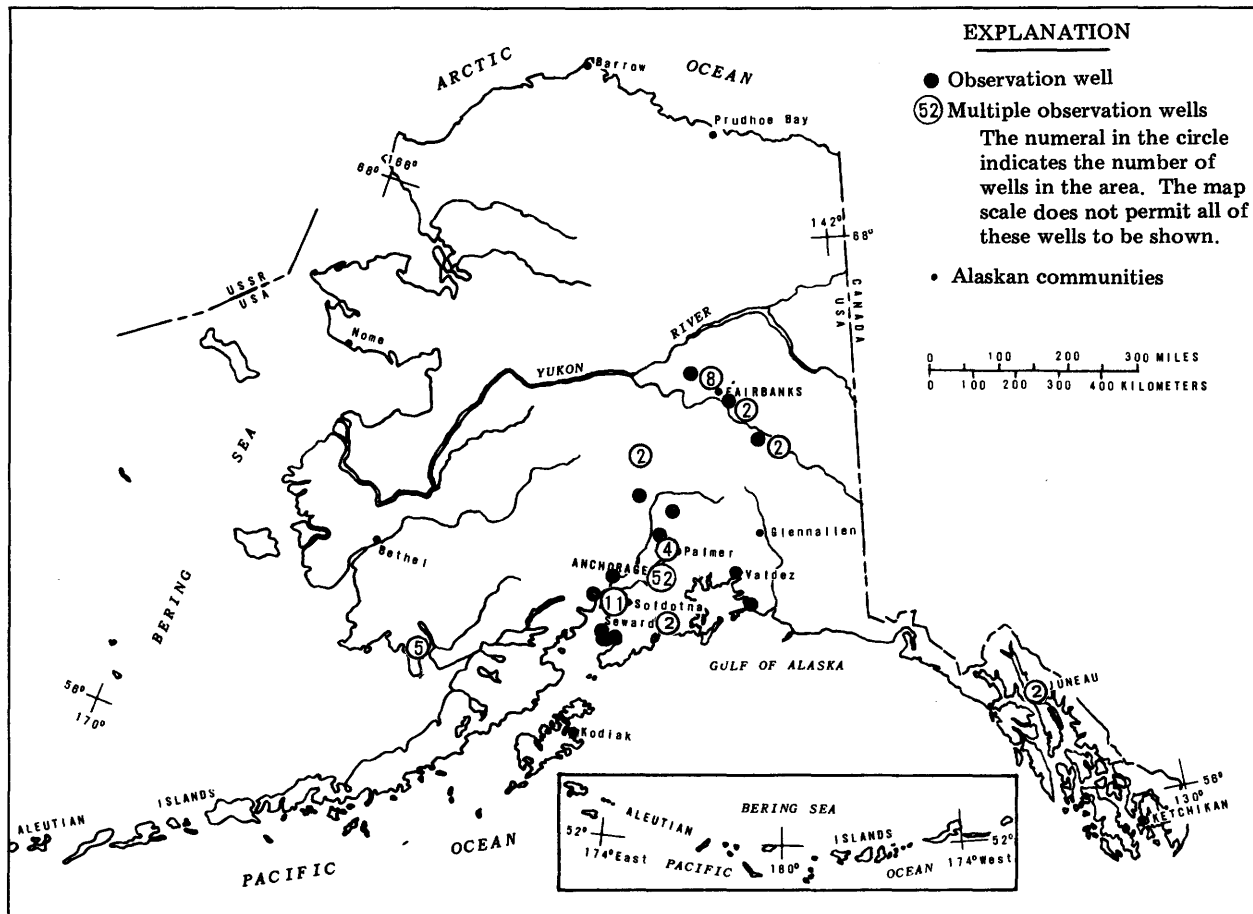


Figure 9.--Location of ground-water observation wells.

hydrologic systems; to study regimes of glaciers that present specific hazards or benefits and the complete cycle of glacier behavior; to advise of hazards and assess glaciers as a resource; to develop and use methods of predicting glacier behavior; and to assess the importance of glaciers in the interpretation of climate.

**Status:** Ongoing studies of glacier hydrology are carried out primarily at Gulkana Glacier in the Alaska Range and at Wolverine Glacier in the Kenai Mountains. Black Rapids Glacier is the site of a study of the dynamics of surging glaciers. Project personnel are also assessing predictions of retreat of Columbia Glacier. In 1981 the glaciers on Mount Spurr were investigated as a source of flood water should the volcano erupt. Ice inventory by state-wide aerial photography is a continuing part of the project.

The project location is shown in figure 10.

#### NORTHERN REGION

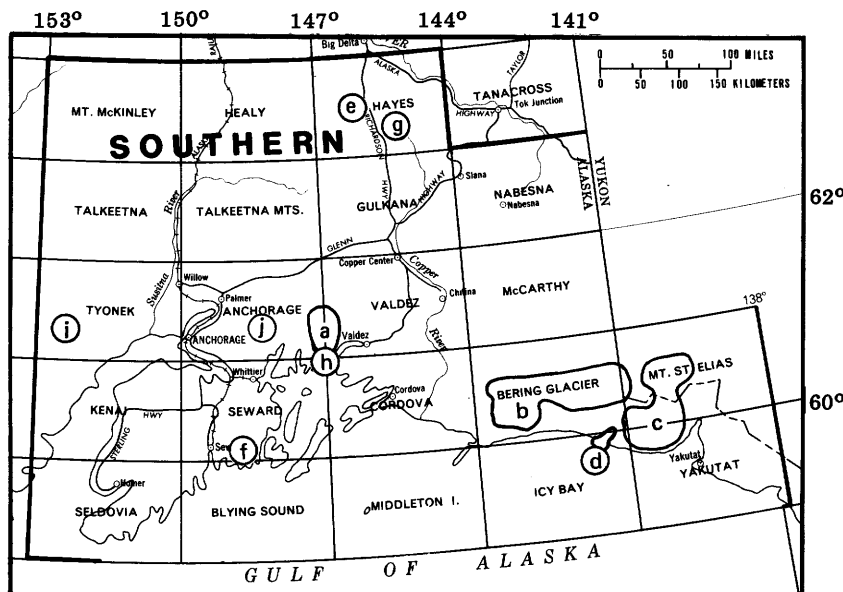
**Project Title:** Geochemistry of Oilfield Waters, National Petroleum Reserve in Alaska

**Chief:** Yousif K. Kharaka

**Objectives:** To study the chemistry and controls on the chemistry of oilfield waters in the National Petroleum Reserve, and to provide geochemical data and interpretation that will aid in assessing the migration and accumulation of petroleum in this area. The chemical data are also necessary to understand the diagenesis in the reservoir rocks and to identify potential pollution, waste disposal, and corrosion problems associated with production.

**Status:** The project is in its fifth year. Gas and water samples have been collected from the Prudhoe oilfield and the Barrow gasfield. Sample collection will continue from existing NPRA wells and, wherever possible, at other North Slope wells. Detailed chemical and isotopic analyses are being made of those samples available. However, few wells have produced water, and data are thus incomplete. Results have been discussed at several conferences. A summary paper is being published in the proceedings of a workshop on clathrates in NPRA that was held in July 1979. A paper titled "Geochemistry of oilfield waters from North Slope, Alaska" is to be included in the Survey's forthcoming Professional Paper on the geology of the Reserve.

## WATER RESOURCES



### EXPLANATION

Water, Ice, and Energy Balance of Snow and Glaciers, and Snow and Ice Physics

- a. Columbia Glacier
- b. Bering Glacier
- c. Malaspina Glacier
- d. Icy Bay

Alaska Glaciology

- e. Black Rapids Glacier
- f. Wolverine Glacier
- g. Gulkana Glacier
- h. Columbia Glacier
- i. Mt. Spurr

Frequency of Recurrence of Lake George at Knik Glacier

- j. Knik Glacier

Figure 10.--Water Resources Division glaciology studies in southern Alaska.

The project location is shown in figure 11.

The project location in shown in figure 11.

Project Title: Arctic Stream Processes

Chief: Kevin M. Scott

Objectives: To determine the processes, rates, and any unique factors involved in the natural behavior of arctic stream channels; to survey the international literature on streams in cold regions; and to determine the response of arctic streams to engineering alterations, such as the removal of large amounts of bed material.

Status: Research pertaining to the first two goals is complete, and the results are published in Professional Paper 1086 and Water-Supply Paper 2056. A paper dealing with aspects of the last objective is in press. Fieldwork was continued on the Sagavanirktok River and its tributaries in August 1981; study results will be prepared for publication in 1982.

Project Title: Water Resources of the North Slope

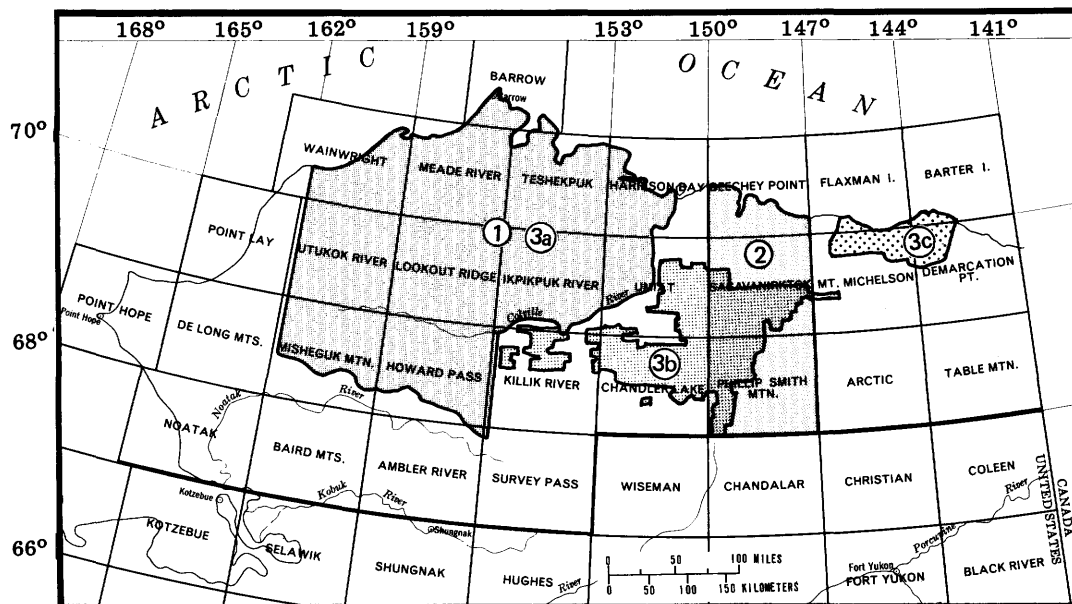
Chief: Charles E. Sloan

Objectives: To study streams, lakes, springs, and aquifer characteristics in order to supply information for planning, design and development of water supplies. Snow cover will also be studied as a source of water and as a protective layer on the tundra.

Status: Data on lakes, springs, and rivers and photographic imagery (from which lake depth and spring location can be determined) are being acquired. FY 1982 field studies include a reconnaissance snow survey and inventory of springs in April and a summer trip to measure lake depth, water quality, and spring flow.

The project location is shown in figure 11.





#### EXPLANATION

1. Geochemistry of Oilfield Waters, National Petroleum Reserve in Alaska
2. Arctic Stream Processes
3. Water Resources of the North Slope
  - a. National Petroleum Reserve
  - b. Central Arctic Management Area
  - c. Arctic National Wildlife Range Coastal Plain

Figure 11.--Water Resources Division activities in northern Alaska.

#### EAST-CENTRAL REGION

**Project Title:** Geohydrology of the Fairbanks North Star Borough

**Chief:** Dorothy E. Wilcox

**Objectives:** To provide basic hydrologic data for land-use planning by (1) studying the surface- and ground-water flow system to define water availability; (2) mapping and describing the water table in the uplands and the artesian zone; (3) defining water quality with special attention to high nitrate and arsenic concentrations in ground water; and (4) assisting residents, officials, and consultants concerning hydrologic problems.

**Status:** Long-term projects designed to measure low flow from small basins in the uplands and monitor ground-water levels in the uplands and lowlands near Fairbanks have been set up since this program began in 1975. A well-inventory - water-quality survey program has been active since 1975. Reports have been published on the arsenic, nitrate (plus nitrite as nitrogen) and iron concentrations and the hardness of water in wells in the Fairbanks area and the Chena Ridge vicinity. A similar report for the Chena Hot Springs Road area is in review, and one is planned for the Sheep Creek - Goldstream Road area. Test drilling in 1977

revealed that arsenic concentrations in ground water in different zones of the bedrock aquifer can vary widely.

A report on hydrologic information for land-use planning in the Fairbanks area was published in 1978. A similar, more specific report addressing the Badger Road area is in preparation.

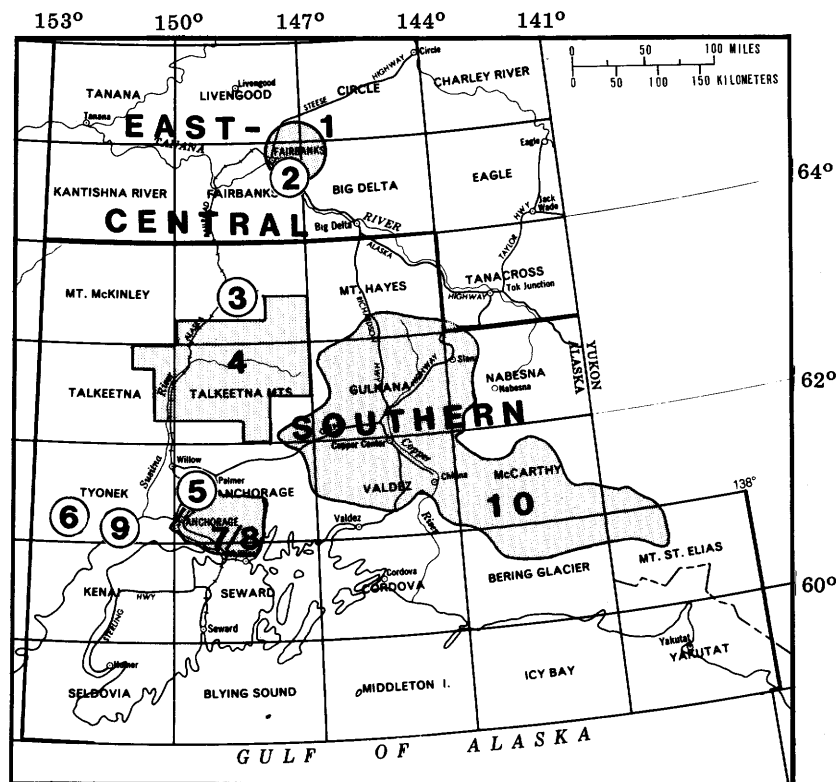
The project location is shown in figure 12.

**Project Title:** Sediment Transport in the Tanana River in the Vicinity of Fairbanks

**Chief:** Robert L. Burrows

**Objectives:** In order to facilitate design and operation of engineering structures on the Tanana River and quarrying of gravel from the river in the vicinity of Fairbanks, the U.S. Army Corps of Engineers, Alaska District, requested that the U.S. Geological Survey collect and evaluate sediment-transport and river-hydraulic data during periods of principal runoff, beginning in 1977. This part of a cooperative effort, the Tanana River Monitoring and Research Program, is administered by the Cold Regions Research and Engineering Laboratory, Alaska Project Office, in Fairbanks. Geological Survey objectives are to provide suspended- and bedload-sediment, hydraulic, and channel-geometry

## WATER RESOURCES



### EXPLANATION

1. Geohydrology of the Fairbanks North Star Borough
2. Sediment Transport in the Tanana River near Fairbanks
3. Trace Metals in Surface Water in Healy and Lignite Creek Basins
4. Total Sediment Transport Below Devils Canyon Dam Site on Susitna River
5. Hydrologic Studies of the Point MacKenzie - Horseshoe Flats Area
6. Evaluation of Hydrologic Hazards from Volcanic Activity at Mt. Spurr
7. Water-Quality Characteristics of Surface-Water Runoff in Chester Creek, Anchorage
8. Geohydrology of the Anchorage Area
9. Chitna Coal Field Study
10. Copper River Basin Hydrology

Figure 12.--Water Resources Division activities in east-central and southern Alaska.

data for use of cooperators on an annual basis, to determine sediment-transport characteristics and related hydraulics, and to evaluate both short- and long-term trends.

**Status:** Data collection began in 1977. Open-file reports containing the data were published in 1978, 1979, and 1981; the last report contains all data from 1977 to 1979. Compilation and analysis of data from 1980 and 1981 are under way. An interpretive report analyzing sediment-transport characteristics shown by the 1977-79 data is nearing completion. Intensive data collection will continue through 1982, and interpretation and analysis of the expanded data base will continue.

The project location is shown in figure 12.

### SOUTHERN REGION

**Project Title:** Trace Metals in Surface Water in Healy and Lignite Creek Basins

**Chief:** Dorothy E. Wilcox

**Objectives:** (1) To determine the concentration and distribution of selected trace elements in surface water in the coal-rich Healy and Lignite Creek basins, and (2) to assess the sources of trace elements in these waters.

**Status:** In 1981 four sets of water-quality and streambed material samples were collected at three sites in the Healy Creek basin and at four sites in the Lignite Creek basin. Water samples were analyzed for concentrations of major ions and sus-

pendent sediment, as well as for five dissolved and total-recoverable trace elements found in concentrations above trace level in the 1980 samples. The water and bed-material samples were also analyzed for trace elements (iron, lead, manganese, nickel, and zinc) and percent coal. Concentrations of trace metals in surface water in the Lignite Creek basin are generally higher than those in surface water in the Healy Creek basin. One ground-water sample and 11 bedrock samples were also obtained from the basins for analysis.

Data collection for this project was completed in 1981. The final report is in preparation.

The project location is shown in figure 12.

Project Title: Total Sediment Transport Below Devils Canyon Dam Site on Susitna River

Chief: James M. Knott

Objectives: To define total sediment transport by the Susitna River below Devils Canyon. Specific objectives are to define: (1) suspended-sediment transport rate as a function of discharge; (2) size distribution of suspended sediment as a function of transport rate; (3) bedload transport as a function of discharge; (4) size distribution of bedload as a function of transport rate; (5) spatial distribution of total sediment transport; and (6) bed-material particle-size distribution.

Status: Sediment sampling will begin in May 1982. Plans call for a basic-data release at the close of the 1982 field season.

The project location is shown in figure 12.

Project Title: Hydrologic Studies of the Point MacKenzie - Horseshoe Flats Area

Chief: Leslie D. Patrick

Objectives: To evaluate the hydrologic boundaries, aquifers, aquifer materials, and quality of ground water and lakes in the Point MacKenzie - Horseshoe Flats area. The applicability of digital models will also be evaluated.

Status: The study encompasses approximately 120 square miles. In 1981 two test wells were drilled in the study area. A report titled "Results of Exploratory Drilling at Point MacKenzie, Alaska, 1981" describes the lithology and water quality. Geophysical logs were run, and a water-level recorder was installed on one of the wells. Water-quality, water-level, and bathymetric data were collected from Horseshoe Lake and Lake Lorraine. Lake levels were also measured on Twin Island Lake and Lost Lake. Data collection will continue through 1982. Plans call for a final report in 1983.

The project location is shown in figure 12.

Project Title: Evaluation of Hydrologic Hazards from Volcanic Activity at Mount Spurr

Chief: Richard P. Emanuel

Objectives: To assess the hazards posed by possible eruptions of Mount Spurr, particularly ice- and snowmelt, floods and mudflows, formation and destruction of lakes, stream-channel changes due to erosion and deposition of sediment, contamination of water resources with ash or other sediment, and other hydrologic hazards and impacts in the affected area. Specific objectives are to: (1) obtain aerial photographs of floodways in the Beluga and Chakachatna River systems; (2) obtain adequate ground control for photogrammetry and large-scale topographic mapping using the above aerial photographs, and to produce such maps; (3) simulate catastrophic flooding in the Beluga and Chakachatna River systems using a computer model of dam-break floods; (4) evaluate and map areas at risk from possible mudflows, floods, ashfall, and other volcanic and related phenomena; and (5) identify facilities that could be affected by volcanic activity on Mount Spurr.

Status: About 90 percent of the aerial photography of the Beluga and Chakachatna River systems was obtained in 1981, the first year of the project. Nearly 25 survey control points were selected using a combination of satellite receivers, ground electronic instruments, and helicopter-mounted surveying equipment; additional points will be chosen in 1982 to meet photogrammetric requirements. Preliminary computer simulations of dam-break floods have been run with the available data.

The project location is shown in figure 12.

Project Title: Water-Quality Characteristics of Surface-Water Runoff in Chester Creek, Anchorage

Chief: Timothy P. Brabets

Objectives: To describe the chemical, physical, and biological characteristics of baseflow, snowmelt, and rainfall runoff in Chester Creek. These characteristics will be related to climate and land-use characteristics. Data will also be used to calibrate and verify two Survey rainfall models: the Distributed Routing Rainfall Runoff Model, and the Precipitation Runoff Modeling System.

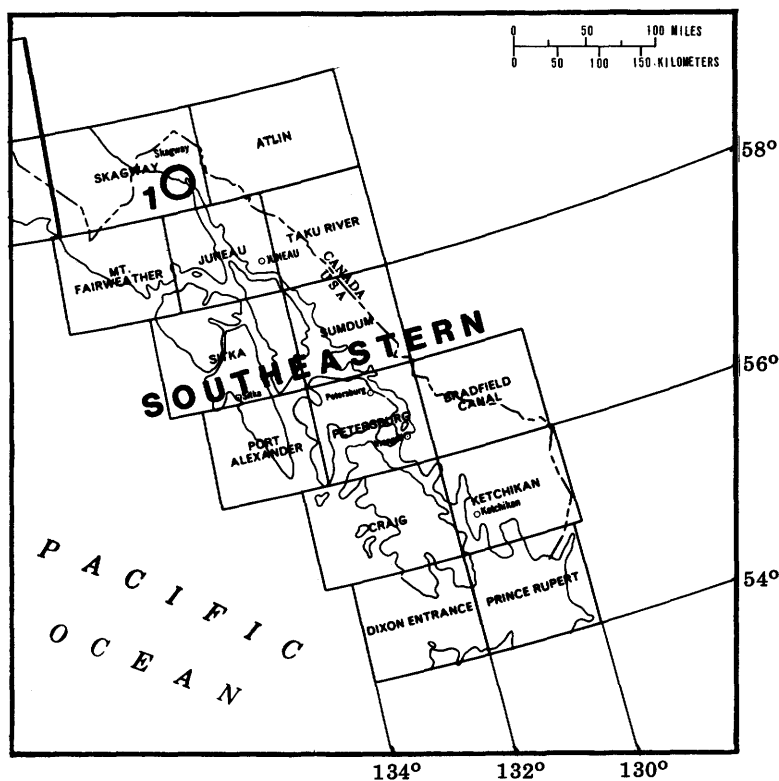
Status: Gaging stations have been installed on the South Branch of the South Fork Chester Creek in the basin headwaters and on Chester Creek at Arctic Boulevard. Stage recorders, rainfall and snow collectors, and automatic pumping samplers are set up to acquire data in areas of commercial and high- and low-density residential land uses. Sampling will begin in 1982.

The project location is shown in figure 12.

Project Title: Geohydrology of the Anchorage Area

Chief: Timothy P. Brabets

Objectives: (1) To maintain a hydrologic data-collection network for streamflow, lake levels, and ground-water levels in the Anchorage area; (2) to



**EXPLANATION**

1. Water Resources of the Chilkat River Basin near Haines

**Figure 13.--Water Resources Division study in southeastern Alaska.**

maintain and update a two-dimensional digital model of the confined aquifer system in the Anchorage area to simulate the hydrologic effects of groundwater development; and (3) to describe hydrologic characteristics of selected areas in Anchorage where hydrologic information is required to help make land-use planning decisions.

**Status:** The general hydrologic character of this area was described early in this 14-year-old project. Current project activities include: (1) operation of the basic-data collection network of six stream-gages, 52 wells for water-level measurements, and lake-level measurements at eight lakes; (2) collection of aquifer test pumping information to update and operate the digital model of the confined aquifer system; (3) collection and interpretation of hydrogeologic data in the Peters Creek - Eklutna area and preparation of a report on the results of the study; and (4) collection and interpretation of water-quality information for Campbell Creek.

The project location is shown in figure 12.

**Project Title:** Baseflow Study of the Chuitna Coal Field

**Chief:** Gordon L. Nelson

**Objectives:** To identify aquifers that contribute to baseflow of the Chuitna River, a major spawning habitat, and predict how mining will affect baseflow; to define the composition of water in springs that supply baseflow to the streams.

**Status:** This project began in mid-1982.

The project location is shown in figure 12.

**Project Title:** Water Resources of the Copper River Basin

**Chief:** Philip A. Emery

**Objectives:** To present water-resources information in a format understandable by local water users and managers, and to provide a guide to future water-resource development so potential water users may avoid costly and futile efforts to obtain adequate amounts of good quality water.

**Status:** The project began in mid-1982.

The project location is shown in figure 12.

**Project Title:** Frequency of Recurrence of Lake George at Knik Glacier

Chief: Larry R. Mayo

Objectives: To determine the mechanism that causes the formation and discharge of Lake George and the parameters that can be measured to predict that occurrence.

Status: Lake George was dammed by Knik Glacier and burst out annually for many years prior to 1966, but an ice dam has not formed since that date. The glacier has not retreated from the ice-dam point, and outburst flooding could resume, threatening current and expected economic and residential development downstream. The glacier is presently growing thicker and steeper. In 1981 project personnel measured a record 17.0 meters of snow in a crevasse in the glacier. Ice radar measurements show that part of the lower glacier is below sea level. The spacing between surface-point altitude measurement sites has been decreased from 5 to 2 kilometers for greater precision in detecting waves in glacier flow. Data are sent annually to the State's Division of Geological and Geophysical Surveys, and a final report is planned for 1983.

The project location is shown in figure 10.

## SOUTHEASTERN REGION

Project Title: Water Resources of the Chilkat River Basin near Haines

Chief: Edward F. Bugliosi

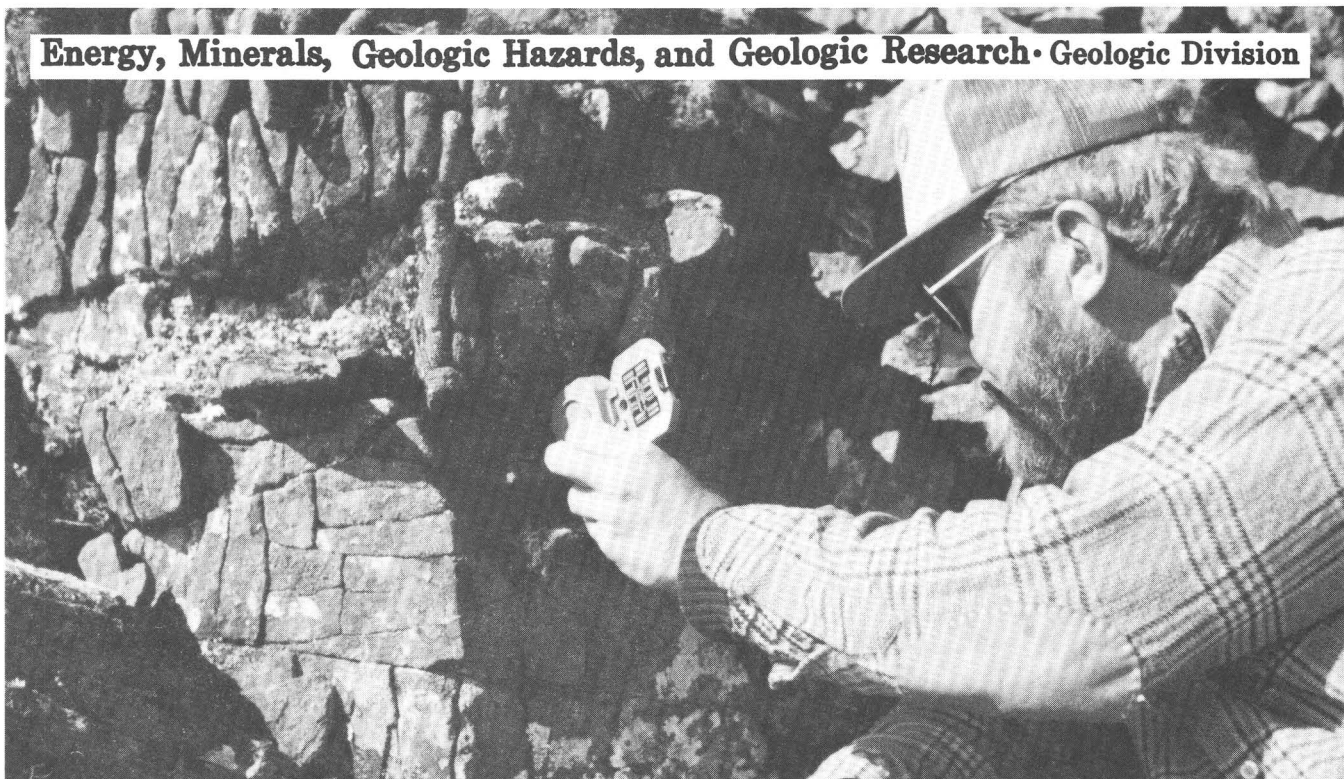
Objectives: To describe the hydrologic system of the Chilkat River basin near the Tsirku fan, a critical habitat area for bald eagles; to estimate streamflow characteristics in ungaged parts of the Chilkat River basin; and to determine baseline water quality in the basin.

Status: To date, historic data have been compiled. The Survey made miscellaneous measurements, sampled the water quality of selected rivers in the basin, and established a continuous recorder at a site on the Klehini River in 1981. Project personnel have also studied the bathymetry and water quality of Chilkat Lake. Some of the planned observation wells have been drilled on the Tsirku River fan. Data from the wells will be used to develop a working model of the fan.

The project location is shown in figure 13.



## Energy, Minerals, Geologic Hazards, and Geologic Research • Geologic Division



Measuring the dip of the Kanayut Conglomerate in the Brooks Range.

For further information, contact the offices listed below.

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## ENERGY, MINERALS, GEOLOGIC HAZARDS, AND GEOLOGIC RESEARCH

The current scientific program of the Geologic Division in Alaska is primarily related to mineral- and energy-resource appraisal, earthquake and geologic hazards, and geologic research conducted in support of these programs. This work includes geologic mapping and mineral-resource evaluation, primarily at scales of 1:250,000 and 1:63,360; mineral district mapping and evaluation; mineral-resource appraisal; geochemical studies and sampling, particularly related to mineral deposits; petroleum-resource surveys; aeromagnetic and gravity surveys and interpretation; engineering geology studies in urban areas and along transportation corridors; earthquake studies; isotopic age determination and interpretation; heat-flow studies; and submarine sampling, subbottom profiling, and other geologic and geophysical studies of the ocean floor.

Activities in Alaska are the responsibility of several working groups within the Geologic Division: the Branch of Alaskan Geology with headquarters in Anchorage, the Office of Earthquake Studies, the Office of Energy Resources, and the Office of Marine Geology at the Western Region Headquarters in Menlo Park, Calif.; the Branches of Regional Geophysics, Electromagnetism and Geomagnetism, Exploration Research, Isotope Geology, and Engineering Geology at the Central Region Headquarters in Denver, Colo.; and the Branch of Paleontology and Stratigraphy at the National Museum in Washington, D.C. Several other branches in the Geologic Division provide services or conduct research in cooperation with these units.

The Branch of Alaskan Geology is headquartered in Anchorage at Gould Hall on the Alaska Pacific University campus; Branch offices are located in Fairbanks and at the Western Region in Menlo Park, Calif.; the Branch of Regional Electromagnetism and Geomagnetism maintains observatories at Fairbanks (College), Barrow, Adak, and Sitka. The College and Barrow observatories are under the direction of John B. Townshend, whose office is in Fairbanks. The Sitka Observatory is directed by Willis E. Osbakken, and David Evans is in charge of the Adak facility.

This section on the Geologic Division first describes the major mission-oriented programs in Alaska and then describes the current projects in Alaska by geographic region. Figures 14 through 23 show the locations of current division activities.

The major program elements of the Geologic Division in Alaska are:

- The Alaska Mineral Resource Assessment Program (AMRAP) and related projects
- The North Slope Petroleum Program and related Alaska-wide energy studies
- The Arctic Environmental Studies Program
- The Marine Geology Program
- The Earthquake Hazards Reduction Program
- Volcanic Hazards Program
- Climate Change Program

- Alaska Geothermal Research Program
- Geologic Framework and Synthesis Program
- Geologic research in support of these program elements

Most of these programs are interrelated. Several Arctic Environmental Studies projects, for example, are designed to determine and mitigate the environmental effects of oil exploration, production, and transportation in the Arctic. The Marine Geology Program, similarly, is designed to determine the petroleum potential in the continental shelf areas off the coast of Alaska and to determine geo-hazards related to placement of oil and mining facilities on the sea floor. The North Slope Petroleum Program is designed to assess petroleum and other mineral resources of northern Alaska.

### ALASKA MINERAL RESOURCE ASSESSMENT PROGRAM

The Alaska Mineral Resource Assessment Program (AMRAP), coordinated by Gary R. Winkler in Anchorage, began in 1975. The program was developed to provide objective and timely information on Alaska's mineral endowment to public and private interests concerned with exploration, classification, and development of Alaska lands. The program is evolving to meet the mandates of the Alaska National Interest Lands Conservation Act (ANILCA), which went into effect in December 1980. The act calls for mineral resource assessment of all public lands in Alaska and enlarges the scope of AMRAP to consider mineral fuels as well as non-fuels minerals, thereby necessitating more cooperative projects with other Federal and State agencies.

The two basic goals of AMRAP continue to be: (1) in the near term, to assess on a 1:1,000,000-scale base the State's mineral resources to provide input to persons in the Congress and the Department of the Interior who are concerned with National mineral policy; and (2) for long-range planning, to conduct systematic interdisciplinary studies of 1:250,000-scale quadrangles, giving priority to quadrangles that are believed to have the most significant potential for mineral resources. The first goal has been met for much of Alaska; completion of a summary assessment of the southeastern part of the State is scheduled for 1983. The second goal is now the main focus of the program and is being addressed at an accelerated pace in FY 1982.

AMRAP consists of four levels of study: Level I--statewide summaries (now essentially completed) of the State's mineral resources based on past and present investigations by the Survey and by other agencies; II--identification of regions of mineral potential, including some measures of the favorability for and probable sizes and grades of undiscovered deposits in these regions; III--interdisciplinary studies of specific 1:250,000-scale quadrangles, each containing more than 7,000 square miles, and related topical studies; and IV--detailed studies of mineral deposits or districts and related technical studies. One project under Level II is continuing. In Level III, projects in eight quadrangles are ongoing, and four will start



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in FY 1982. Twenty-seven detailed or topical studies in Level IV are underway.

Many of the AMRAP project chiefs are members of the Branch of Alaskan Geology. However, the program supports projects of the Branches of Regional Geochemistry, Regional Geophysics, Field Geochemistry and Petrology, Petrophysics and Remote Sensing, and the Isotope Geology Branch in the Office of Geochemistry and Geophysics; of Exploration Research, Resource Analysis, and Western Mineral Resources in the Office of Mineral Resources; of Coal Resources, Oil and Gas Resources, and Uranium-Thorium Resources in the Office of Energy Resources; and of Paleontology and Stratigraphy in the Office of Regional Geology. In addition, AMRAP has supported, and will continue to support, topical studies that range from detailed work in small areas to work of statewide and international scope.

Under ANILCA the total program area has expanded to encompass more than 280,000 square miles. Level III studies have been completed or are underway for about 40 percent of the area; figure 14 indicates the current status of Level III AMRAP studies. Geological mapping and geochemical or geophysical studies are scheduled for 16 quadrangles in 1982; fieldwork in 23 quadrangles has been completed and reports have been published or are in press for those quadrangles.

### NORTH SLOPE PETROLEUM PROGRAM

The North Slope Petroleum Program, directed by Kenneth J. Bird of the Branch of Oil and Gas Resources in Menlo Park, consists of a number of projects whose goals are to assess the petroleum potential of the North Slope of Alaska. Specifically, the program's objectives are to determine, map, and describe, on the surface and in the subsurface, by geologic, geophysical, and geochemical methods: (1) the structural framework and regional structural trends in the Brooks Range and North Slope; (2) depositional environments and lateral relations of Paleozoic, Mesozoic, and Cenozoic facies; (3) possible hydrocarbon reservoirs and their regional trends; (4) paleontologic, lithologic, and electric log correlations across the North Slope; (5) the thermal history, hydrocarbon source potential, and relations of extracted hydrocarbons to known North Slope oils; and (6) the geologic history of the area as it relates to potential reservoirs, source and seal rocks, hydrocarbon formation and migration, and present structural trends.

Currently, five projects comprise the North Slope Petroleum Program. All projects are regional in extent and can be classified as basin analysis studies. The projects include: a basin-framework study, primarily of Cretaceous and Tertiary rocks of the eastern North Slope; a tectonic-stratigraphic study of pre-Cretaceous rocks in the northern part of the National Petroleum Reserve in Alaska (NPRA); petroleum source-rock geochemical studies; reservoir and resource assessment studies; and a low-level aeromagnetic survey for detection of anomalies produced by hydrocarbon seepages. Funding is from the Office of the National Petroleum Reserve in Alaska and the Branch of Alaskan

Geology. The direction of future Oil and Gas Branch work on the North Slope is the extension of NPRA studies to adjacent areas.

### ARCTIC ENVIRONMENTAL STUDIES PROGRAM

The Arctic Environmental Studies Program is under the direction of Oscar J. Ferrians, Jr., of the Branch of Alaskan Geology in Menlo Park. The program objectives are: (1) to investigate transportation corridors and other areas of development in Alaska in order to obtain baseline geotechnical data needed for land-use planning and to aid in planning, designing, operating, and maintaining engineering structures so that adverse environmental impacts will be minimized; to evaluate feasibility of proposed projects; and to prepare comprehensive Environmental Impact Statements; and (2) to observe and record geotechnical maintenance and environmental problems that arise during the operation of the trans-Alaska oil pipeline in order to determine the location, character, and extent of these problems and their relation to geologic conditions and processes. These observations will allow an evaluation of the adequacy of the technical stipulations in controlling adverse environmental impacts and make it possible to improve stipulations for future engineering projects that would have a significant impact on the environment.

Continuing projects in the Arctic Environmental Studies Program include: Tanana Valley transportation-development corridor studies, eastern Arctic Coastal Plain Quaternary studies, surficial geology of the Central Brooks Range, western Arctic Coastal Plain Quaternary studies, and Copper River Basin Quaternary studies. Other major activities during 1982 include: (1) continuing compilation of a new permafrost map of Alaska; (2) continuing preparation of a major report describing the present state of knowledge of permafrost conditions in Alaska; (3) continuing compilation of a comprehensive permafrost bibliography; and (4) special study of Kobuk sand dunes.

### MARINE GEOLOGY PROGRAM

The Alaskan continental shelf is larger than the combined shelves of the rest of the United States. The energy and mineral potential of this shelf area is and will continue to be a major segment of national resource programs. The primary mission of the Survey's Marine Geology Program is to provide scientifically interpreted information about the (1) resource potential, (2) geo-hazards setting, and (3) overall geologic characteristics of the continental margin and adjacent shallow and deeper coastal areas of Alaska. The program focuses on the investigation of the regional geologic framework and on geo-environmental problems that typically require the gathering of widely spread and publicly available geophysical and geologic data. In contrast, the Minerals Management Service's program, described elsewhere in this circular, prepares detailed resource and geo-environmental data analysis for evaluations of specific 3-mile-square tracts. The combination of regional geologic synthesis compiled by the Geologic Division and the detailed assessments by the Minerals Management Service provides a comprehensive understanding of

the oil and gas resource potential of an area and the geologic hazards that may affect exploration and production activities.

Although the bulk of the regional resource studies of continental margins is directed at energy deposits, investigations are also conducted to determine mineral resources, both hard-rock and placer deposits, and the availability of construction materials such as sand and gravel, which may bear on energy resource development. Energy resource investigations are concentrated in areas proposed or that have potential for leasing activity.

The hazards program involves seafloor characterization studies, analyses of processes active on the seabed, and geo-hazard assessments. In Alaskan areas, the studies are designed first to determine the regional relations and then to focus on the specific geo-hazards and the processes that form them. Geo-hazards include recent or active faulting, seabed erosion or scour, sediment transportation and deposition, slumping and related mass-sediment movement, gas accumulations in the shallow subsurface, and ice-gouging of the seafloor.

These studies also involve basic or applied research needed to improve our ability either (1) to collect or interpret scientific data or (2) to understand processes that shape or modify the seabed and its underlying rocks. The theoretical and technological results of these endeavors bolster our resource and geo-hazards programs, as well as enrich the Nation's storehouse of scientific knowledge.

The Marine Geology Program is coordinated by Robert W. Rowland of the Office of Marine Geology in Menlo Park. The projects are described under the regional heading Offshore.

### **EARTHQUAKE HAZARDS REDUCTION PROGRAM**

Earthquakes pose serious hazards to life and property in Alaska. Severity of the hazard was amply illustrated by the great Alaska earthquake of 1964. More earthquakes occur in Alaska than in the rest of the United States. Accordingly, the State is a fertile natural laboratory for investigations into the cause and geologic effects of earthquakes. On the basis of patterns of historic earthquake activity, large earthquakes (magnitude 7 or greater) are expected to occur in the Shumagin Islands and Yakataga region with the next few decades. The program in Alaska is part of a national program mandated by the Earthquake Hazards Reduction Act of 1977 (Public Law 95-124). Under the act, the responsibility for research on earthquake hazards is divided between the Survey and the National Science Foundation (NSF). The Survey is responsible for research related to prediction, induced seismicity, and hazards assessment. The NSF is responsible for engineering and research for utilization of mitigating procedures. Much of the funding in the national overall program goes to universities, private groups, and other government services in addition to the Survey's program. As a result, the Survey closely coordinates its program in Alaska with the Geophysical Institute of the University of Alaska in Fairbanks

and with the National Oceanic and Atmospheric Administration (NOAA). Observatories are maintained in Adak, Sitka, and Barrow, in addition to the Fairbanks facilities. The program in Alaska is coordinated by Robert D. Brown of the Earthquake Studies Branch in Menlo Park.

In addition to the projects listed by region in the pages that follow, the Survey supports several projects at institutions or in agencies outside the Federal Government. They include those listed below:

#### **Earthquake Hazards Studies**

Geotechnical soils investigations, upper Cook Inlet area.--This study involves determination of sensitive clay failure and sand liquefaction susceptibility of Quaternary soils in the study area in response to a seismic event. This includes the mapping of engineering soils units and establishing a geotechnical data bank. Collection of subsurface soils data continues, and a program for computer storage is being devised. The pilot study of Bootlegger Cove Clay slope stability and stratigraphy in the Government Hill area of Anchorage, which was based on three-dimensional engineering mapping, has resulted in two reports that are in review. A similar study of southwest Anchorage is well underway. In addition, geologic mapping of the Anchorage B6-NW quadrangle (Eklutna Lake area, north of Anchorage) is complete; that study recognized active faults cutting both bedrock and Holocene glacial deposits. Strain history studies of 1964 landslides in the Anchorage area are complete, and a report is in review. The project chief is Randall Updike of the Alaska Division of Geological and Geophysical Surveys in Anchorage.

#### **Earthquake Prediction Studies**

Crustal deformation measurements in Alaskan seismic gaps - Yakataga and the Shumagin Islands.--The project chiefs are Roger Bilham and John Beavon of the Lamont-Doherty Geological Observatory at Columbia University, New York City. To date, three groups of strainmeters have been installed, and more instrumentation is planned. The project's objective is to test whether precursory strain changes in an epicentral region can be used to predict time of rupture.

Field study of earthquake prediction methods in the central Aleutian Islands.--Project chiefs are Carl Kisslinger and Selena Billington of the University of Colorado in Boulder. A goal of the project is to develop the capability to predict earthquakes of magnitude 5 or greater. Data are provided by a seismograph network and by measurements of tilt, gravity, mean sea level, vertical line levelling, and long-term tectonic stability.

### **VOLCANICS HAZARDS PROGRAM**

This nationwide program involves geologists, geochemists, geophysicists, and hydrologists in

## GEOLOGIC

assessing the hazards to life and property associated with volcanic eruptions and investigating the prediction of eruptions. Examination of recently active volcanoes to determine the frequency and character of their eruptions and to monitor their geophysical and geochemical activities constitute a major part of the program. In Alaska, field studies have been completed on Mount Redoubt, a volcano on the west side of Cook Inlet, and final reports are in preparation. Fieldwork will continue on Mount Spurr, another volcano on the west side of Cook Inlet, and Mount Edgecumbe, a volcano in southeastern Alaska, near Sitka. For information about this program, contact Thomas P. Miller, Branch of Alaskan Geology, Anchorage.

### CLIMATE CHANGE PROGRAM

The Geological Survey's Climate Change Program seeks to provide a basic understanding of the reasons for and mechanisms of climatic changes. It provides information on the natural variability of the climate system from a geologic perspective, emphasizing independent, coordinated multidisciplinary studies of long and continuous records where possible. Investigators are members of nearly a dozen branches or divisions of the Survey. Among the program's goals are: establishing a long-term history of rates, frequencies, and magnitudes of climate change; determining the effects of climate change on natural resources; and developing and improving techniques for delineating climate history. The program provides a geologic data base as input for, or validation of, numerical models being used to predict climate change as a result of manmade or natural alterations of climate. Major study topics include lakes, isotopes, carbon dioxide concentrations, terrestrial-marine correlations, and syntheses of findings.

Two projects in Alaska are funded by the Climate Change Program. Both involve analysis of lacustrine sediments as the basis for developing regional zonation for correlation of late Quaternary deposits and for tracing the climatic history of southern Alaska.

For more information about the program, contact its coordinator, Richard Z. Poore, 908 National Center, Reston, Va. 22092.

### GEOTHERMAL RESEARCH PROGRAM

The Geothermal Research Program of the U.S. Geological Survey is a multidisciplinary program with the goal of understanding the nature, distribution, and energy potential of the Nation's geothermal resources. The program is administered by the Geologic Division and consists of geologic, geochemical, geophysical, and hydrologic studies that are conducted within the Geologic Division and the Water Resources Division. Much of the information produced by the Geothermal Research Program bears directly on those activities of the Minerals Management Service that are related to classification, evaluation, and leasing of Federal lands for geothermal development.

Individual projects fall into one of six topical categories, which are: (1) general studies of geothermal systems and of the transfer and storage

of geothermal heat; (2) regional geothermal investigations; (3) studies of hydrothermal systems and fluid geochemistry; (4) studies of volcanic systems and magma chambers; (5) studies of geopressurized systems; and (6) development of geophysical and geochemical techniques for geothermal exploration and assessment.

Participation by the Branch of Alaskan Geology in the Geothermal Research Program is through regional geothermal investigations. One geothermal project is currently active in the State. James Riehle of the Branch of Alaskan Geology in Anchorage is overseeing program activities in Alaska.

### GEOLOGIC FRAMEWORK AND SYNTHESIS PROGRAM

This program is designed to develop and synthesize basic information on the geologic framework of the Nation. The program performs the dual function of acquiring baseline earth science information for subsequent support of mission activities of the U.S. Geological Survey such as resource assessment or mitigation of geologic hazards, and synthesizing geologic information gathered by other programs to develop new geologic concepts or up-to-date syntheses of regional geology. Three principal subelements constitute the program: (1) Geological, geochemical, and geophysical surveys to determine the distribution and properties of rocks and unconsolidated materials; (2) studies to determine the ages of those materials in order to determine rates and frequencies of particular geologic processes; and (3) studies of geologic processes responsible for the formation, modification, and distribution of those materials within and at the surface of the earth.

Activities of the Geologic Framework and Synthesis Program in Alaska are directed toward understanding the tectonic and intrusive igneous history of parts of the State. Geologic investigations in south-central and southeastern Alaska are studying the distribution and ages of "suspect" terranes, belts of rocks that may have moved thousands of kilometers northward to their present sites in Alaska. Geophysical studies in the program are measuring the orientations of weak remanent magnetic fields in rock of these "suspect" terranes in order to identify the original position of the rocks with respect to known ancient positions of the Earth's magnetic poles. Other projects in the program are investigating distribution, compositions, ages, and origin of plutonic rocks in the Alaska-Aleutian Range batholith, the chronology of Quaternary deposits in northern Alaska, and the biostratigraphy of Paleozoic Radiolaria. Another project is devoted to compiling a map of magnetic anomalies in North America. These projects will contribute to understanding the evolution and crustal framework of these areas and the relations between igneous intrusions and mineral deposits there. Finally, several investigations in the program are providing critical age determinations of rocks throughout Alaska, using paleontologic and isotopic techniques.

Further information about this program is available from Glen A. Izett, 908 National Center, Reston, Va. 22092; Tel. (703) 860-6411.

## PROJECTS OF THE GEOLOGIC DIVISION STATEWIDE

Project Title: Alaska Geothermal Project (Alaska Geothermal Program)

Chief: James R. Riehle

Objectives: To carry out a reconnaissance evaluation of the geothermal resources of the State of Alaska. Particular emphasis is now being given to volcanic centers of the Alaska Peninsula, eastern Aleutian Islands, the Wrangell Mountains, and Mount Edgumbe. Studies of the distribution of rock types, chemistry, and eruptive history of selected volcanic centers are being conducted in order to evaluate the potential for shallow heat sources.

Status: Much of the reconnaissance study of the volcanic rocks of the Aleutian volcanic arc and the Wrangell Mountains is now complete and in the report-preparation stage. Field studies in FY 1981 included: (1) mapping and sampling of centers active during Holocene time on the Alaska Peninsula (Ugashik quadrangle), (2) sampling for geochronologic studies of Wrangell lavas, and (3) investigation of Holocene activity of the Edgumbe volcanic field. Activities in FY 1982 include laboratory analysis and preliminary data reduction of samples from the FY 1981 field season. Field studies will continue in FY 1982.

Project locations are shown in figure 15.

Project Title: Uranium in Alaska

Chief: Thomas P. Miller

Objectives: To make a reconnaissance study of the uranium and thorium potential of plutonic rock terranes in Alaska in terms of their geologic setting, petrologic characteristics, and associated uranium-thorium deposits.

Status: Reconnaissance geologic studies have been conducted on uraniumiferous plutonic rocks in the eastern Seward Peninsula, west-central Alaska, and the northern Alaska Range. Several reports describing uranium-thorium distribution and mineralization have been published, and several more are in the report-preparation stage.

The project location is shown in figure 15.

Project Title: Alaska Geologic Earthquake Hazards (Earthquake Hazards Reduction Program)

Chief: George Plafker

Objectives: To study and evaluate risk in Alaska from tectonic displacement, seismic shaking, and secondary geologic effects. A more general goal is to gain insight into tectonic processes within the seismically active zones of Alaska, with special emphasis on south-central Alaska.

Status: Fieldwork is essentially complete. The project has included reconnaissance studies of

known or suspected active faults in Alaska and evaluation of marine terrace sequences in the Gulf of Alaska region.

Project Title: Coal Resources of Alaska

Chief: Gary D. Stricker

Objectives: (1) To evaluate coal resources in the National Petroleum Reserve in Alaska (NPRA) and AMRAP study areas in Alaska by geologic mapping, drill core data, and geophysical methods; (2) to prepare cross sections showing coal bed correlations and coal distribution in the NPRA and AMRAP study areas; (3) to provide resource estimates by area and bed for selected parts of these areas; and (4) to assess coal quality by use of Btu values, sulfur and ash content, and major-, minor-, and trace-element concentrations.

Status: In 1980 fieldwork was done in the Broad Pass quadrangle where active surface subsidence over an abandoned coal mine is of environmental concern. A report on the subsidence is in preparation. Reconnaissance studies of the Mystic Creek coal basin and of an unnamed basin near Newman Creek in the northeast part of the Healy quadrangle resulted in collection of samples and measurement of sections for studies of depositional environment and coal resources. Other work for the Healy AMRAP project and NPRA is continuing. The type and location of fieldwork in 1982 will be determined by arrangements with other projects.

The project location is shown in figure 15.

Project Title: Placers of Alaska

Chief: Warren E. Yeend

Objectives: To reassess gold placer resources of Alaska by mapping deposits and by compiling reports that show and describe: location and extent (vertical and lateral) of deposits; history of exploration; texture and lithology of gravel and heavy minerals; past production and value per cubic yard; sources of gravels and gold; resources remaining; and age of deposits and geologic history.

Status: Fieldwork and reports are complete for the Mount Hayes quadrangle. (See Open-File Report 81-0355 and Circular 823-B.) Fieldwork is complete in the Circle and Healy quadrangles. Laboratory analysis is under way on panned samples, and maps and reports are being prepared for these quadrangles. Some information is included in Circular 844.

The project location is shown in figure 15.

Project Title: Alaska Fragments/Tectonic Map of Alaska

Chief: David L. Jones

Objectives: (1) To identify, characterize, and interpret the major tectonostratigraphic terranes that form the main mass of Alaska, and to show

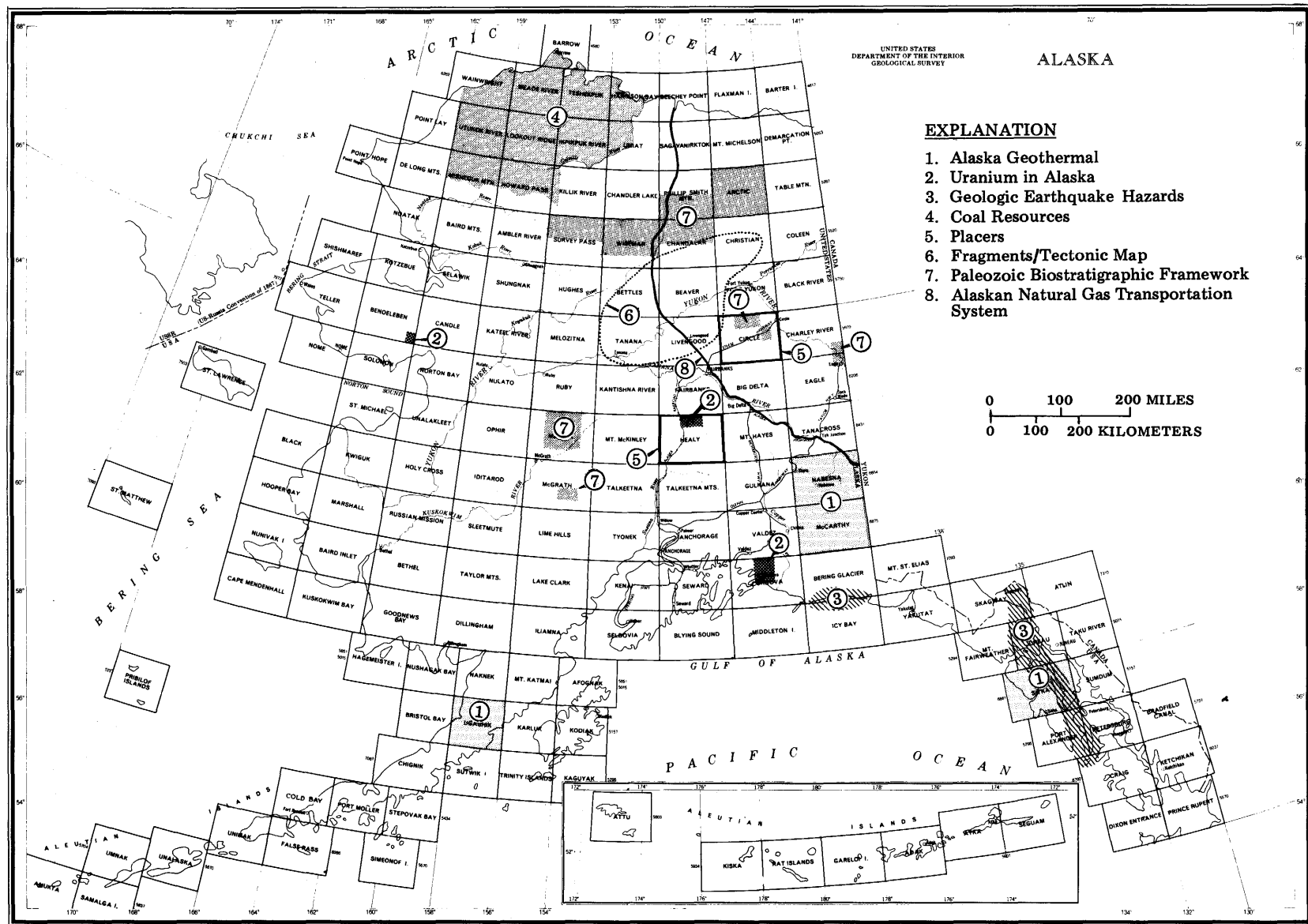


Figure 15. -- Geologic Division activities statewide in Alaska.

their distribution on a tectonostratigraphic terrane map (scale 1:2,500,000); (2) to compile a tectonic map of Alaska (in quadrants at a scale of 1:1,000,000) that portrays: (a) the internal structural features of each terrane, (b) the structures produced during accretion of allochthonous terranes, and (c) structures that post-date the accretionary history; and (3) to determine by paleomagnetic methods the amount of displacement that selected terranes have undergone.

**Status:** A preliminary terrane map was completed during FY 1981 (Open-File Report 81-0792). Field studies in the central Alaska Range and in Denali National Park and Preserve were completed in FY 1980, and a map at a scale of 1:250,000 will be released in FY 1982. Compilation of the first sheet of a preliminary version of a tectonic map of Alaska is scheduled for FY 1982. Analysis of paleomagnetic data on lower Cenozoic volcanic rocks of the central Alaska Range has been completed. In FY 1981, field studies in the Rampart area of north-central Alaska began in order to establish the stratigraphy and structure of the Innoko terrane. In FY 1982, this study will be extended northward in to the Bettles area.

The project location is shown in figure 15.

**Project Title:** Paleozoic Biostratigraphic Framework of Alaska

**Chief:** J. Thomas Dutro, Jr.

**Objectives:** To establish a biostratigraphic framework of Paleozoic sequences in three parts of Alaska: (1) Ordovician through Devonian of the eastern Medfra quadrangle, west-central Alaska; (2) Devonian of the central and eastern Brooks Range, northern Alaska; and (3) Carboniferous (upper part of Ford Lake Shale and Calico Bluff Formation) of east-central Alaska.

**Status:** This project was initiated in FY 1980. Fieldwork has been completed for parts (1) and (3) and is continuing for part (2) in the Wiseman quadrangle through the summer of 1982. The study elements have been summarized in numerous reports, and more reports are in progress. Additional field reconnaissance in 1981 was done in the McGrath and Circle quadrangles.

The project location is shown in figure 15.

**Project Title:** Alaska Natural Gas Transportation System

**Chief:** John R. Williams

**Objectives:** To provide geologic, hydrologic, and geo-technical advice to Federal agencies responsible for reviewing plans and designs and for granting permits for construction of the Alaska Natural Gas Transportation System by Alaskan Northwest Natural Gas Transportation Company. This is done mainly through membership on the Cold Regions

Engineering Technical Committee of the Office of the Chief of Engineers, U.S. Army, established to advise the Federal Inspector, Alaska Natural Gas Transportation System, and also upon direct request of the office of the Federal Inspector.

**Status:** The Cold Regions Engineering Technical Committee meets two or three times per year with representatives of the Federal Inspector, the Alaskan Northwest Natural Gas Transportation Company, the gas producers, and the Trans-Alaska Pipeline System owners, as necessary, to discuss the company's frost heave research program and the field and laboratory tests that produce data necessary to provide input into the frost heave model and to verify it. In addition to participating in these meetings, project personnel serve on the Committee's Field Tests and Investigations Task Group which meets four or five times per year, as required, for direct communication with the technical staff of Alaskan Northwest Natural Gas Transportation Company and its consulting engineers, geologists, and hydrologists. Occasionally, requests are received directly from the Office of the Federal Inspector for assistance in fields within the expertise of the Survey, e.g. location and design of crossings of active faults.

The project location is shown in figure 15.

**Project Title:** Geochemical Census of Alaska

**Chief:** Larry P. Gough

**Objectives:** To establish background values for the concentration of about 35 elements in unconsolidated surficial materials and selected native plants. Such information is valuable in the evaluation of geochemical data for (1) mineral resources, (2) environmental appraisals, and (3) the definition of broad-scale geochemical patterns. Analysis of the soil sample provides a measure of the total concentration of each element at a site, and analysis of the associated plants permits an estimate to be made of the concentrations of the elements available to biogeochemical cycling and soil enrichment. The study will produce a series of maps showing the concentration of elements in surficial materials and plants. By sampling two sites per 1:250,000-scale quadrangle (one site being replicated) in a projected total of about 140 quadrangles, we will obtain about 420 surficial material samples distributed so that they are separated by 80-160 kilometers.

**Status:** For about 5 years this effort progressed slowly on a non-funded, time-available basis. Two years ago the project chief attained quarter-time funding which made possible limited fieldwork in the south-central region. The project had depended, however, on the volunteer assistance of individuals going into areas where samples are needed; more than 35 persons from numerous government agencies and public and private universities have participated.

To date, 208 locations in 94 quadrangles have been visited. The collection includes about 300 soil and 180 plant samples. Sample-site coverage is being assessed, and regions with particularly low sample-

site densities will be targeted for sampling by the project chief and an assistant. We estimate that 120 hours of fixed-wing flying in FY 1982 will be necessary to complete the sampling phase of the project. Sample preparation and analysis will begin in late FY 1982; 2 or 3 months will be needed to catalogue, sort, and process the samples. The analytical phase of the project will be accomplished in FY 1983.

The areas sampled, as of October 1, 1981, are shown in figure 16.

Project Title: Mineral Resources of Alaska

Chief: Edward H. Cobb

Objectives: As a continuing project, to keep office studies of mineral occurrence data current and to prepare special-purpose maps, reports, and reference lists when the need arises. Most data are organized so that they are available for entry into computerized storage and retrieval banks.

Status: As this is a continuing project, percentage-of-completion data are not applicable; records are up to date as of December 31, 1981.

Project Title: Alaska Gravity Surveys

Chief: David F. Barnes

Objectives: To provide gravity data that can contribute to Alaska mineral assessments, geologic mapping, and earthquake studies. A corollary is to standardize all government, university, and industry gravity surveys in Alaska by maintaining a network of base stations that can be readily re-occupied during local surveys or after earthquakes and that are accurately tied to sites of absolute measurements.

Status: A 1:2,500,000-scale simple Bouguer anomaly map of Alaska was published in 1977 and is now being revised. This map provided a preliminary estimate of the variation of crustal thickness, approximate boundaries of many small sedimentary basins, an indication of isostatic adjustment, and information about the regional gradients that are used in the interpretation of more detailed surveys. Most of the recent surveys have been planned as 1:250,000-scale maps designed to support mineral assessments and wilderness area investigations. However, interpretation of such larger scale maps usually requires terrain-corrected data, which have been prohibitively expensive until the recent availability of digital terrain data and development of computer techniques to handle such data.

The most detailed survey yet attempted consisted of closely spaced stations along two perpendicular profiles across a barite outcrop near the Nimiuktuk River in the western Brooks Range. These data suggested that the small outcrop is underlain by about 1.5 million tons of barite. Gravity may also prove useful in locating other massive barite bodies, which geochemical data suggest may be abundant in the Brooks Range. Another very

detailed new data set includes over 50,000 gravity measurements made along seismic lines in the National Petroleum Reserve. Analysis of these data should improve our understanding of Arctic Alaska's gravity and geologic structure.

The base station network has supplied control for many commercial surveys of both land and marine sedimentary basins. These stations were originally described in two open-file reports based on the old Potsdam network, but conversion to the new absolute (IGSN71) world net and datum has caused some confusion which will, it is hoped, be eliminated by a report in preparation.

Reoccupation of many gravity bases after the 1964 earthquake suggested mass increases by thrust fault movements and local mass decreases by elastic expansion. Continuing studies of post-earthquake elevation and gravity changes suggest models involving elastic compression.

Project Title: Anchorage Geochemical Laboratory (AMRAP)

Chief: Richard M. O'Leary

Objectives: To make spectrographic and chemical analyses of geologic material collected from quadrangles that are part of the AMRAP program.

Status: The laboratory facilities in Anchorage will be primarily serving the Bendeleben, Solomon, Wiseman, Killik River, Chandler Lake, and Anchorage AMRAP quadrangles as part of continuing work. Additional samples may be received from new projects in the Port Moller, Table Mountain, and Juneau quadrangles.

Project Title: Metamorphic Facies Map of Alaska

Chief: Cynthia Dusel-Bacon

Objectives: To compile a 1:2,500,000-scale metamorphic facies map of Alaska, showing the facies, facies groups, facies series, selected isograds, and intrusive bodies in the style of the metamorphic facies map explanation suggested by the International Union of Geological Sciences in 1967. A locality map, also at 1:2,500,000, text, and table will accompany the facies map. Uncolored 1:1,000,000-scale metamorphic facies maps, which are regional compilations upon which the final map is based, will be published as separate Miscellaneous Field Studies (MF) sheets. The metamorphic facies map is planned as a contribution to a Map of the Metamorphic Belts of the World, a project sponsored by the Commission for the Geological Map of the World (of the International Union of Geological Sciences). Current plans call for a joint U.S. Geological Survey - State of Alaska, Division of Geological and Geophysical Surveys publication.

Status: Preliminary compilation and review of regional metamorphic facies maps at a scale of 1:1,000,000 for all of Alaska, coding of background metamorphic mineral locality information by individual contributors, and early compilation of the



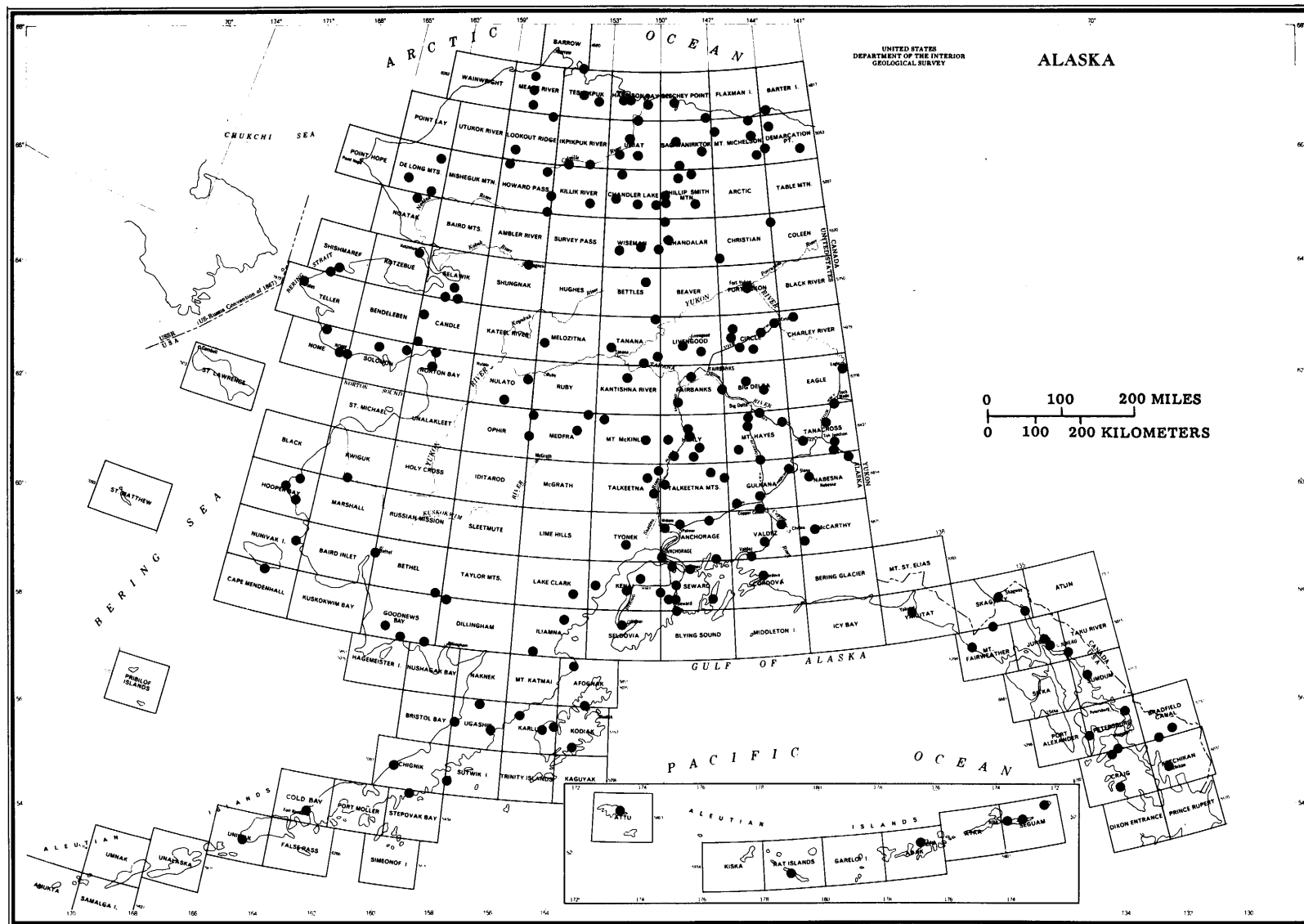


Figure 16. -- Sample-site coverage for geochemical census of Alaska.

1:2,500,000-scale map through February 1981 were carried out under the direction of D. A. Brew. Since then, under the present project chief, compilation of the 1:2,500,000-scale facies and locality maps has been completed, and metamorphic mineral assemblage and age data have been put in a tabular format so that the information can be easily reviewed by all contributors. Because so much additional mapping of metamorphic rocks and radiometric dating has been done since the original information was requested in 1973, considerable updating and revision of the initial information is essential. Revision of the maps and table by former and new contributors is expected to be completed by June 1982. Publication of the 1:1,000,000-scale regional facies maps is planned for 1982-83, and publication of the final 1:2,500,000-scale facies and locality maps, text, and table by 1985.

Project Title: Precambrian of Alaska

Chiefs: Marvin A. Lanphere and G. Donald Eberlein

Objectives: In response to the growing public demand on Earth resources and in recognition of the need for closer examination of the largely overlooked mineral resource potential of the Earth's Precambrian terranes, the Subcommittee on Precambrian Stratigraphy of the International Union of Geological Sciences' Commission on Stratigraphy has established Working Groups in all parts of the world where Precambrian rocks form a significant part of the geology of the region. This program activity, with particular concern for Alaska, is one of seven that constitute the Working Group for the Precambrian of the United States and Mexico. Immediate objectives have been designated as (1) assembly and evaluation of existing pertinent geologic and geochronologic data relevant to Alaskan Precambrian terranes; (2) preparation of a summary geologic report and geochronologic chart for Alaska to be published in a single volume with similar reports for the other regions of the United States and Mexico; (3) formulation of an acceptable time scale for the Precambrian of the United States and Mexico; (4) coordination with the Working Group of Canada in an effort to formulate an acceptable Precambrian time scale for all of North America; (5) identification and designation of reference sections; and (6) revision of the American Commission on Stratigraphic Nomenclature (ACSN) code for the Precambrian.

Status: Objectives (1) and (2) have been fulfilled; the manuscript which reviews and summarizes the existing knowledge of the Precambrian of Alaska, and originally was approved for publication in a special issue of Economic Geology, has now been submitted for publication as a chapter in a Geological Survey Professional Paper. The content of the original manuscript has been revised and updated to reflect new information and developments over the past 3 years. Objective (3) likewise has been fulfilled, and the Working Group's Precambrian time scale proposal for the United States and Mexico has been approved for publication by the ACSN. Efforts to formulate an acceptable Precambrian time

scale for all of North America are continuing, but progress is being delayed because Canadian workers are having difficulties developing an acceptable proposal for that country.

Program activity is continuing on a part-time basis with the indicated Alaskan regional members of the United States - Mexico Working Group (a) keeping other members informed of developments in the understanding of the Precambrian stratigraphy of Alaska, (b) maintaining contact with Canadian counterparts to facilitate resolution of mutual problems on either side of the International Boundary, and (c) working with other members of the Working Group to encourage the definition and integration of all methods of determining the Precambrian record.

Project Title: Uranium Potential of Sedimentary Basins in Alaska

Chief: Kendell A. Dickinson

Objectives: (1) To evaluate the uranium potential of selected sedimentary basins and coastal regions; (2) to compile data on and locate anomalous radioactivity in sedimentary rocks; (3) to determine the environments of sedimentation in each basin and coastal region to delineate nearshore and continental facies most favorable for roll-type uranium deposits; (4) to determine potential granitic and volcanic ash source rocks for uranium near basins and coastal plains; (5) to delineate areas of alteration favorable for uranium deposits and determine hydrology as it relates to movement of uranium-bearing ground water; (6) to evaluate paleo-geochemical conditions suitable for the preservation of potential host rocks; and (7) to define target areas for physical exploration (drilling).

Status: Studies of uranium potential in sedimentary basins have been expanded; their scope is no longer limited to Tertiary basins. Fieldwork in the Healy Creek coal basin and in the Death Valley area in the southeastern part of the Seward Peninsula are about 10 percent complete. Both these areas are known to contain potentially commercial uranium deposits and will be studied more intensively in FY 1982 and 1983. Although bad weather drastically curtailed work on Tertiary rocks along the coast of the Gulf of Alaska in FY 1981, further work there is not planned because the rocks types are not favorable for uranium deposits.

Project Title: Geothermal Studies

Chief: Arthur H. Lachenbruch

Objectives: To investigate heat flow and the geothermal regime of permafrost and sedimentary basins by making thermal observations in holes drilled for other purposes.

Status: Monitoring of post-drilling return to equilibrium of holes drilled in the National Petroleum Reserve is continuing. Thermal data of variable quality have been obtained from about three dozen holes elsewhere in Alaska, and a preliminary account of the results was published in 1981 by

Sass and others in "Physical Properties of Rocks and Minerals, Volume II-2", in McGraw-Hill/CINDAS Data Series on Material Properties, edited by Touloukian and others.

**Project Title:** Geochronological and Petrologic Studies in Central and Western Alaska

**Chief:** Frederic H. Wilson

**Objectives:** (1) To support geologic mapping projects and resource studies in Alaska through use of potassium-argon dating and topical age studies within the framework of the other projects; (2) to build an argon extraction lab in Anchorage; and (3) to maintain a computer-based compilation of Alaskan radiometric age dates.

**Status:** Potassium-argon (K-Ar) dating of rocks from the Ugashik and Circle (AMRAP) quadrangles was initiated in 1979, and the planned work is approximately 50 percent complete. The construction of the argon extraction lab may be under way in 1982. The radiometric age compilation is a continuing project, and percentage-of-completion information is not applicable; however, more than 1,900 dates and 250 references had been entered by fall 1981. Mapping and sampling for K-Ar dating in the Port Moller, Stepovak Bay, and Simeonof Island quadrangles will begin in summer 1982. Similar work is also expected to begin in the Mount Katmai quadrangle in summer 1982.

The project quadrangles are shown in figure 14.

## NORTHERN REGION

**Project Title:** Northern Alaska Engineering Geology

**Chief:** Oscar J. Ferrians, Jr.

**Objectives:** To provide regional engineering/surficial-geologic information to the Minerals Management Service in order to aid personnel in the Service in making decisions regarding regulation of oil and gas exploration and development activities. This will be accomplished by preparing 1:250,000-scale engineering geology maps and tabular text describing pertinent engineering-geologic characteristics of geologic map units.

**Status:** This is the first year of project work. The study area includes all of Alaska north of latitude 68°, with emphasis on areas of oil and gas exploration.

**Project Title:** Engineering Geologic Studies in the National Petroleum Reserve in Alaska (NPR)

**Chief:** Reuben Kachadoorian

**Objectives:** To make engineering-geologic investigations and to provide geotechnical analyses needed for petroleum exploration of NPR. Investigations include, but are not limited to, determining sources of construction materials and evaluating site locations of such facilities as airstrips, roads, drill sites, and construction camps. Project personnel

consult with participants in the NPR program on engineering geology and permafrost-related engineering problems and on engineering-geologic effects of exploration activities in the Reserve.

**Status:** Because the project provides engineering-geologic expertise needed to fulfill responsibilities assigned to the Geological Survey through provisions of the Naval Petroleum Reserves Production Act of 1976, it will continue until these responsibilities are fulfilled.

The project location is outlined in figure 17.

**Project Title:** Quaternary Environments of the National Petroleum Reserve in Alaska (NPR)

**Chief:** Robert E. Nelson

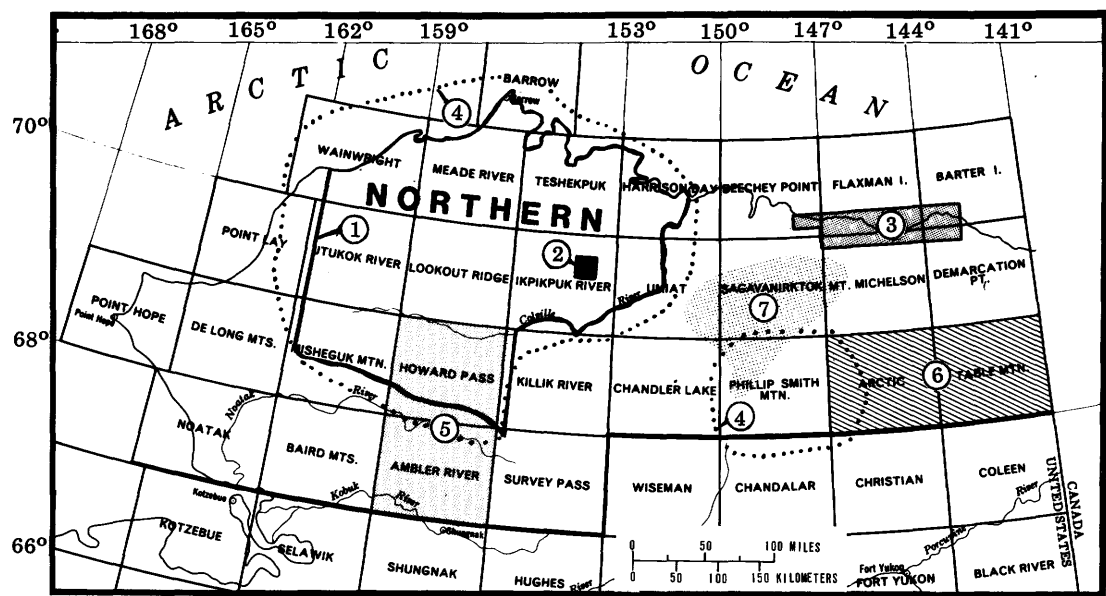
**Objectives:** To provide a record of past environments and climates in the National Petroleum Reserve in Alaska. It is hoped that the record will extend back in time at least 40,000 years, if not farther. The techniques to be used in reconstructing the record include pollen analysis, studies of fossil insects, and studies of plant macrofossils such as seeds and fruits.

**Status:** The project was initiated in 1979. The base camp was on the Titaluk River near the center of NPR. The project chief and Robert D. Norris collected approximately 250 kilograms of vertebrate remains, pollen samples, and screen-washed concentrates of organic debris to process for recovery of fossil insects and seeds. Most vertebrate remains were not found in place, but the mammalian fauna has a typically late Pleistocene aspect and includes mammoth (found in place and carbon-dated at 28,000-40,000 years), *Bison*, horse, musk ox, and rare *Saiga* antelope remains. The analyses of pollen samples from several horizons greater than 28,000 years old indicate that the climate may have been harsher than that of the present. Insect remains from a horizon dated at 28,000 years suggest that local climatic conditions were very similar to those of the present. Increasing percentages of grass and sage (*Artemisia*) pollen in sediments younger than 28,000 years old are interpreted as an indication of increasingly arid environments, which culminated in the steppe-tundra that characterized much of Alaska and Siberia at the height of the last glaciation. Sediments of late Wisconsin (Itkillik II and III) age are apparently absent from the sections studied.

Sediments dated at about 9,600 years old contain the remains of at least two plant species not found so far in the north today: Balsam poplar (*Populus balsamifera*), which is found in the Brooks Range foothills to the south, and the chenopod *Corispermum hyssopifolium*, which is not known from north of the Yukon drainage. Insect fossils in this assemblage seem to indicate a less moist upland surface than that which characterizes the tundra at the present time.

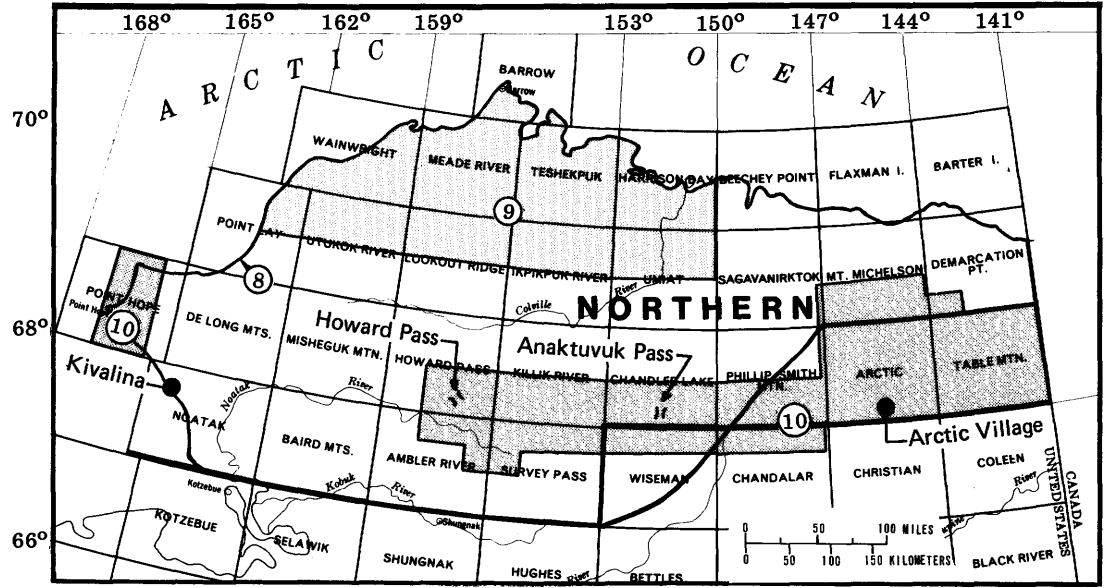
The project is scheduled to be completed by June 1982.

The project location is shown in figure 17.



**EXPLANATION**

- 1. National Petroleum Reserve boundary
- 2. Quaternary Environments of NPRA
- 3. Low Altitude Aeromagnetic Surveys
- 4. Petroleum Assessment Geology
- 5. Surficial Geology of the Central Brooks Range
- 6. Southeast Brooks Range Geology
- 7. North Slope Cretaceous Studies



**EXPLANATION**

- 8. NPRA Oil and Gas Source Rock Study
- 9. Western Arctic Coastal Plain Quaternary
- 10. Brooks Range Devonian Clastic Rocks

Figure 17.--Geologic Division activities in northern Alaska.

Project Title: Low Altitude Aeromagnetic Surveys  
(North Slope Petroleum Program)

Chief: Terrence J. Donovan

Objectives: To determine whether hydrocarbons seeping from buried reservoirs may have sufficiently reduced iron oxides to form magnetite in shallow superincumbent rocks, permitting aeromagnetic detection.

Status: In 1981 a transverse gradiometer was used to obtain data in the petroleum prospective portion of the Arctic National Wildlife Refuge. Additional surveys were flown to tie this to the Prudhoe Bay area. Results of 1979 surveys will be included in a Professional Paper describing the geology of the National Petroleum Reserve in Alaska. Sampling and preliminary analyses of available core data suggest that rocks within anomalous areas have a relatively large remanent magnetism, and isotopic data from carbonate cement indicate the effects of petroleum microseepage. Results of work in 1981 are being prepared for publication.

The general area of the project work is shown in figure 17.

Project Title: Petroleum Assessment Geology, North Slope Provinces (North Slope Petroleum Program)

Chief: Kenneth J. Bird

Objectives: To provide the data and interpretations necessary to assess the petroleum potential of the North Slope. Assessment requires the identification and quantitative evaluation of reservoir rocks, source rocks, and timing of petroleum generation and migration relative to trap formation. Goals include a better understanding of the North Slope hydrocarbon system(s) resulting in improved assessments and stimulation of industry exploration.

Status: In the past year, results of these regional studies have been published in a series of open-file reports. These include: 1) the petroleum exploration history of the North Slope; 2) machine-generated displays, each consisting of six well logs and an interpretive lithologic column, for 81 North Slope wells; and 3) the stratigraphy and depth of penetration for 228 North Slope wells. Nearing completion is the geologic documentation of the NPRA resource appraisal, the petroleum potential of the Philip Smith Mountains quadrangle, Lisburne Group reservoir potential, and the characteristics of Nanushuk Group reservoir rocks.

The project location is shown in figure 17.

Project Title: Surficial Geology of the Central Brooks Range (Arctic Environmental Studies Program)

Chief: Thomas D. Hamilton

Objectives: To provide data for assessment of potential transportation corridors across the central Brooks Range and for other studies involving

land-use analysis and land classification. This objective is being accomplished through preparation of 1:250,000-scale surficial geologic maps showing (1) character, age, and genesis of unconsolidated deposits and (2) locations of landslides, debris flows, and other hazard zones. A general stratigraphic framework, based on measured sections, radiocarbon dates, soil analyses, and geomorphic relationships, is also being developed for the region. This framework has tied together glacial and nonglacial deposits of the northern and southern Brooks Range and provides a basic structure to which other Quaternary deposits in northern and central Alaska can be related.

Status: Surficial geologic maps have been published for six quadrangles: Philip Smith Mountains (Miscellaneous Field Studies MF-878-A), Chandalar (MF-879-A), Chandler Lake (MF-1121), Wiseman (MF-1122), and Killik River (MF-1234), and Survey Pass (MF-1320). Completion of field mapping in the Ambler River and Howard Pass quadrangles is scheduled for the summer of 1982, and surficial geologic maps for those areas will be prepared the following year.

The location of the project is shown in figure 17.

Project Title: Southeast Brooks Range Geology

Chief: William P. Brosgé

Objectives: To complete geologic mapping of the Arctic and Table Mountain quadrangles at 1:250,000 scale, and to revise mapping in adjacent quadrangles.

Status: The mapping is about 60 percent completed. Fieldwork in the Arctic quadrangle was finished in 1979, and about 25 percent of the Table Mountain quadrangle has been mapped in the field. A map of the Table Mountain quadrangle, based largely on interpretation of aerial photographs, was placed on open file in 1976. A geologic map of the Arctic quadrangle based on the recent fieldwork should be completed for publication in 1982. Fieldwork planned for 1982 in the Table Mountain quadrangle will be done as part of the AMRAP project.

The project location is shown in figure 17.

Project Title: North Slope Cretaceous Studies (North Slope Petroleum Program)

Chief: Cornelius M. Molenaar

Objectives: To study the stratigraphy, depositional environments, petrography, reservoir properties, and paleontology of Cretaceous rocks at the surface and in the subsurface of the North Slope in order to assess the hydrocarbon potential and other economic aspects of these rocks.

Status: Three seasons of fieldwork and associated surface and subsurface studies have been completed since 1977. Two seasons' work concentrated on the Nanushuk Group. Results of this and subsurface work were published in Circulars 794 and 820 in

1979, and another final circular is in preparation. In addition, summary articles are published in Circular 804-B (1979) and in Circular 823-B (1981). In 1980 fieldwork was devoted to a study of the Fortress Mountain Formation (Lower Cretaceous) and the lower part of the Torok Formation (Lower Cretaceous), and to the Cretaceous and lower Tertiary stratigraphy in northeastern Alaska. Preliminary results of the two projects are in Circular 844. A more complete report on the Cretaceous and lower Tertiary stratigraphy of northeastern Alaska is in preparation.

At least four additional reports on various aspects of Cretaceous rocks in the National Petroleum Reserve in Alaska (NPRA) will be included in a Professional Paper describing the geology of the reserve. Three of these reports have been released as Open-File Reports 81-0967, 81-1084, and 81-1222.

Surface and subsurface studies of Cretaceous strata, including 3 weeks of field work in 1982, are currently being initiated in the area between NPRA and the William O. Douglas Arctic Wildlife Range.

The project location is shown in figure 17.

Project Title: National Petroleum Reserve in Alaska Oil and Gas Source Rock Study (North Slope Petroleum Program)

Chief: Leslie B. Magoon

Objectives: To provide data and interpretations necessary to assess oil and gas source potential of possible hydrocarbon source horizons in the National Petroleum Reserve in Alaska and adjacent areas.

Status: Analytical data for this study are being provided by Geochem Research, Inc., Houston, Texas, and Global Geochemistry, Canoga Park, Calif. To date, more than 35,000 analyses have been completed. Petroleum Information, of Denver, Colo., is building and maintaining the data file of these analyses and implementing graphical displays. Publications, co-authored with George Claypool, include vitrinite reflectance and C<sub>1</sub>-C<sub>7</sub> hydrocarbon gas data for 13 wells and a study of oil types on the North Slope. Numerous additional reports are in various stages of preparation.

The boundary of the project's study area is shown in figure 17.

Project Title: Petroleum Assessment Geology of the National Petroleum Reserve in Alaska (NPRA) (North Slope Petroleum Program)

Chief: Charles E. Kirschner

Objectives: To compile a synoptic overview of the stratigraphy and structure of NPRA based on well and seismic data that will highlight significant petroleum exploration fairways; and to conduct detailed subsurface mapping on the Barrow Arch to integrate and interpret all currently available sub-

surface well and geophysical data as a basis for petroleum assessment.

Status: The project will be completed by October 1982.

The study area is shown in figure 17.

Project Title: Western Arctic Coastal Plain Quaternary (Arctic Environmental Studies Program)

Chief: L. David Carter

Objectives: To determine the Quaternary history of the western Arctic Coastal Plain (marine transgressions, episodes of eolian activity, fluvial terrace development, paleoclimate, tectonic history, and the like) through stratigraphic and geomorphic studies, and to define relations between modern landscape attributes (topography, thaw-lake characteristics, and ground-ice distribution, among others) and Quaternary history, in order to predict the effects of natural or man-induced environmental changes.

Status: Detailed sampling of key exposures and geomorphic analyses of the terrain will be continued in 1982. Reports describing pingos, fossil insects, Pleistocene shorelines, Holocene eolian deposits, and marine and alluvial terraces of the Colville River delta region were published in Circulars 804-B, 823-B, and 844. Preliminary results of studies of amino-acid geochronology of Quaternary marine deposits were presented at the Ninth Annual Arctic Workshop in April 1980, and an analysis of middle Wisconsin through Holocene climatic change was presented at the Tenth Annual Arctic Workshop in March 1981. The abstracts volumes for the workshops, published by the Institute of Arctic and Alpine Research, University of Colorado, contain three abstracts describing these studies. A report describing a Pleistocene sand sea has been published in "Science" (v. 211), and papers concerning marine transgressions and Wisconsin and Holocene eolian sand movement are in preparation.

The project location is shown in figure 17.

Project Title: Brooks Range Devonian Clastic Rocks

Chief: William P. Brosge

Objectives: To determine from surface exposures the environments of deposition, the directions of sediment transport, and the present facies trends of the Upper Devonian and Lower Mississippian Kanayut Conglomerate and the Lower Mississippian Kekiktuk Conglomerate, and to relate the present trends of these directional features in the rocks exposed in the Brooks Range to those in the less disturbed rocks beneath the North Slope by means of paleomagnetic studies and by regional interpretation of Late Devonian and Early Mississippian paleogeography.

Status: The project is more than three-quarters completed, and all the originally planned fieldwork has been done. In 1978 and 1979 the Kanayut

Conglomerate was mapped from the Canadian border near Arctic Village to the Howard Pass area, about 600 kilometers to the west, and was examined in detail at many localities. In addition, the Kekiktuk Conglomerate was examined north of Arctic Village and southeast of Howard Pass, and about 500 cores of Devonian and Mississippian rocks were collected from the outcrops for paleomagnetic study. In 1980 the Kanayut was examined in detail around its type area east of Anaktuvuk Pass, and in 1981 the Kanayut was examined briefly in its westernmost outcrops near Kivalina. The regional study has demonstrated that the three fluvial members of the Kanayut Conglomerate are persistent from east to west; that there were at least two major sites of sediment influx, one near the Canadian border, the other near Anaktuvuk Pass; that the direction of transport of sediment was consistently to the southwest and west; and that the Kanayut is consistently rich in chert. On the other hand, variation in the composition and direction of transport of the sediments in the Kekiktuk Conglomerate from place to place suggests many local sources. Pole positions have been determined for all the surface cores in the paleomagnetic study. These indicate that the observed magnetic orientation was reset by a Cretaceous event. One of the two oriented cores from National Petroleum Reserve wells near Point Barrow that were studied for comparison shows a similar post-Triassic remagnetization. However, hematite of probable Mississippian age in the other core has a stable magnetic component and gives a pole position consistent with counter-clockwise rotation of northern Alaska. An Early Mississippian paleogeologic map of northern Alaska based on surface mapping and on a separate geophysical study of basement rocks in the reserve is in preparation. Plans for 1982 call for examination of the basal Mississippian clastic rocks exposed near Point Hope in order to compare them with the Kekiktuk Conglomerate.

A geologic map of the members of the Kanayut Conglomerate in the central Brooks Range, regional paleocurrent maps for the Kanayut and Kekiktuk Conglomerates, and reports on data from the 1978 and 1979 fieldwork have been placed on open file. Reports on the 1980 fieldwork and on revision of the stratigraphy of the Kanayut have been written. Final reports on the stratigraphic and paleomagnetic studies will appear as chapters in the Professional Paper summarizing recent geologic work in the petroleum reserve.

The project location is shown in figure 17.

**Project Title:** Eastern Arctic Coastal Plain (Arctic Environmental Studies Program)

**Chief:** Oscar J. Ferrians, Jr.

**Objectives:** To complete reconnaissance engineering-geologic investigations that will provide baseline geotechnical data needed for land-use planning and engineering purposes. Planned fieldwork includes engineering-geologic mapping at a scale of 1:125,000. Studies of permafrost conditions and geomorphic features and other permafrost-related geologic processes important to arctic engineering

will be emphasized. Potential geotechnical problems that require special consideration include: slope stability, drainage conditions, frost action, thawing of permafrost, availability of natural construction materials, swelling soils, earthquake effects, erosion, flooding, and icings.

**Status:** The project has been recessed in FY 1982.

**Project Title:** Geology and Resource Potential of the Killik River and Chandler Lake (1:250,000) Quadrangles (AMRAP)

**Chief:** John Kelley

**Objectives:** To assess potential oil, gas, phosphate, and other mineral resources of Federal lands in these quadrangles, which cover a significant part of the overthrust belt of the Central Brooks Range.

**Status:** Assessment of the resource potential of Federal lands is mandated in the Alaska National Interest Lands Conservation Act (Public Law 96-487), enacted on December 2, 1980. This is the first full year of project activity. Two seasons of fieldwork are planned. Fieldwork will include detailed geologic mapping and stratigraphic studies of key areas to determine the structural style and distribution of potential hydrocarbon reservoir rocks in this part of the Brooks Range and North Slope. Maps will be compiled at a scale of 1:250,000, incorporating details from key areas. In addition, sedimentological studies will assess regional environments of deposition that may have influenced accumulation of potential hydrocarbon, coal, and phosphate deposits. Stream-sediment and bedrock sampling for geochemical assessment of mineral potential in the area is also under way.

The quadrangles' location is shown in figure 14.

**Project Title:** AMRAP Geochemistry, Killik River and Chandler Lake (1:250,000) quadrangles, Brooks Range

**Chief:** Stanley E. Church

**Objectives:** To appraise the metallic mineral resource potential of the Killik River and Chandler Lake quadrangles. Regional geochemical sampling will be conducted using stream sediments and heavy-mineral concentrates of stream sediments. Interpretive geochemical maps and statistical treatment of data along with geologic and geophysical studies will aid in outlining mineralized areas of possible economic value. These areas will be studied in more detail by closer spaced sampling using other modes of sample media in addition to the above.

**Status:** Regional stream-sediment and heavy-mineral-concentrate sampling of the mountainous area of the Killik River quadrangle and for about 60 percent of the Chandler Lake quadrangle was completed in the 1981 field season. However, the heavy-mineral-concentrate samples for the latter area were lost in shipment. Substitution of additional types of analysis of stream sediments as an alternative to resampling is being investigated.

The project location is shown in figure 14.

**WEST-CENTRAL REGION**

**Project Title:** Yukon-Koyukuk Transect (AMRAP)

**Chief:** William W. Patton, Jr.

**Objectives:** To determine the composition and structure of the crust beneath the Yukon-Koyukuk basin and to gain an understanding of the tectonic history of the basin. Specific objectives include: 1) comparison of trace element and isotope chemistry of Cretaceous and Tertiary volcanic and plutonic bodies emplaced in the basin with those emplaced in the borderlands in order to identify differences in crustal composition; 2) mapping and geochemical study of the ophiolite assemblages that rim the basin in order to characterize their composition and affinities; 3) geophysical modelling of the large gravity and magnetic anomalies known to exist along the margins of the basin; and 4) detailed structural studies to compare and contrast structural styles of the basin and borderlands.

**Status:** Fieldwork in 1982 will focus on the southeastern margin of the Yukon-Koyukuk basin in the Kanuti River drainage. It will include detailed geologic mapping and geophysical investigations of the ophiolites and metamorphic terrane exposed along the basin margin.

Project location is shown in figure 18.

**Project Title:** Geology and Resources of Norton Sound - Yukon Region

**Chief:** William W. Patton, Jr.

**Objectives:** To complete regional geologic framework investigations and selected detailed topical studies in order to provide basic data for appraising the mineral potential of the project area and the petroleum potential and environmental hazards of contiguous parts of Norton Sound. Project elements include: (1) completion of the regional (1:250,000-scale) geologic maps of Unalakleet, Norton Bay, and Nulato quadrangles; (2) petrologic study and geochemical sampling of the igneous and metamorphic terranes of the Unalakleet quadrangle and Kaiyuh Mountains; (3) paleoenvironmental and sedimentological studies of Cretaceous sediments at selected localities in the Norton Bay and Nulato quadrangles; and (4) examinations of Holocene features along the Kaltag fault and the Norton Sound coastline.

**Status:** Fieldwork is complete in the igneous and metamorphic terranes of the Kaiyuh Mountains and in the central part of the Unalakleet quadrangle. Compilation of geologic maps of the Nulato and Unalakleet quadrangles is under way. In 1982 fieldwork will focus on sedimentological studies of Cretaceous rocks at selected localities in the Norton Bay quadrangle and on petrologic studies of Late Cretaceous and Tertiary volcanic assemblages in the eastern part of the Unalakleet quadrangle.

The project location is shown in figure 18.

**Project Title:** Quaternary History of Climate and Regional Palynostratigraphy, West-Central and

Southwestern Alaska (Climate Change Program)

**Chief:** Thomas A. Ager

**Objectives:** To reconstruct the history of vegetation, limnological conditions, and climate of the Yukon Delta-Norton Sound area during the late Pleistocene and Holocene. Techniques used in this study include pollen and diatom analysis, sediment geochemistry, and radiocarbon dating of samples from lacustrine sediment cores.

**Status:** Fieldwork was completed in 1980. Several reports are in press, and a final report is in preparation.

The project location is shown in figure 18.

**Project Title:** Arctic Mineral Resources (Ophir and Tanana Quadrangles)

**Chief:** Robert M. Chapman

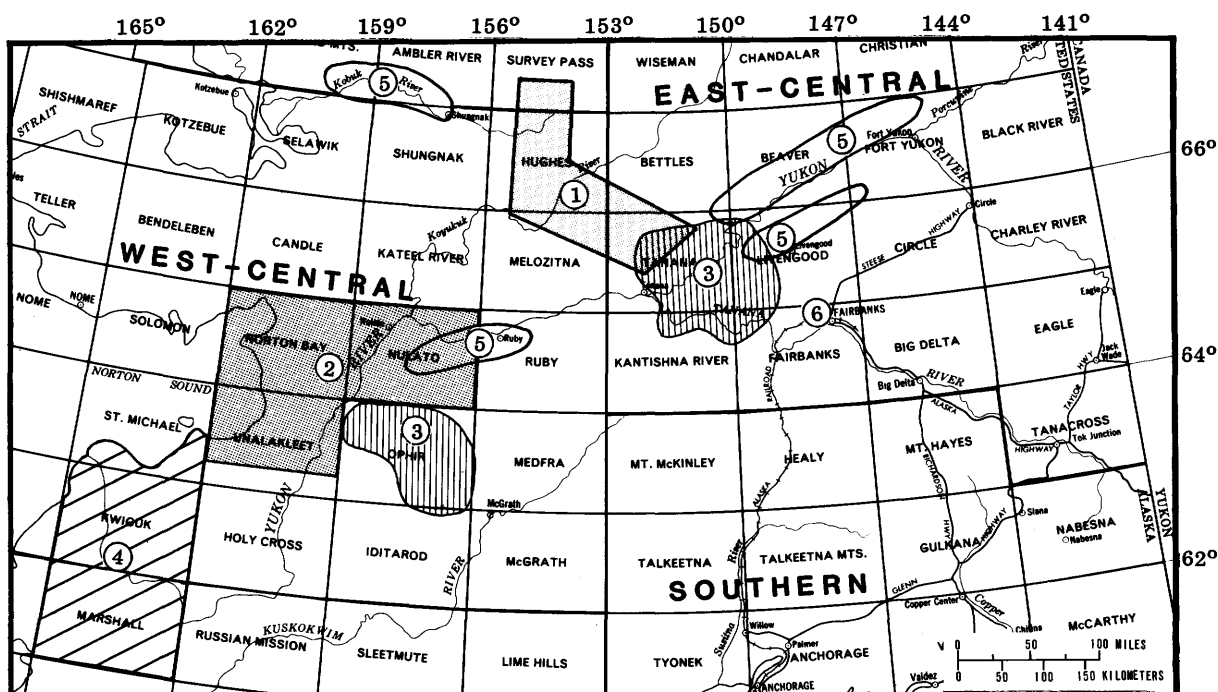
**Objectives:** To map, describe, and interpret the bedrock units, surficial deposits, and structural features in a large part of the Ruby province, and to make regional correlations and tectonic interpretations in order to provide an adequate geologic map and a base for mineral-resource and land-use evaluations of this region. Immediate objectives are (1) completion of field research and mapping in the Ophir quadrangle, and (2) research on problems pertinent to regional geologic interpretations that have been highlighted by previous work in the Ruby, Tanana, Kantishna River, and Livengood quadrangles.

**Status:** Results of geologic studies prior to 1980 are summarized in two open-file 1:250,000-scale geologic maps (the Tanana and northeastern part of the Kantishna River quadrangles, and the west half of the Kantishna River quadrangle) and in eleven reports, including small-scale geologic maps, on the Tanana, Kantishna River, and Ruby quadrangles published in Circulars 683, 700, 733, 751-B, 772-B, 804-B, and 823-B. The work was coordinated with similar studies by others in the adjacent Livengood, Beaver, Bettles, Melozitna, Nulato, and Medfra quadrangles. Ophir, Ruby, and Kantishna River - northern Mount McKinley (1:250,000-scale) geologic maps are being prepared, and a revised geologic map of the Tanana quadrangle has been completed. Mapping of the Ophir quadrangle, initiated in 1980, continued in 1981 but was curtailed by inclement weather. A progress report on the 1980 work is included in Circular 844. Completion of geologic studies in the Ophir quadrangle is planned, dependent on level of funding for 1982.

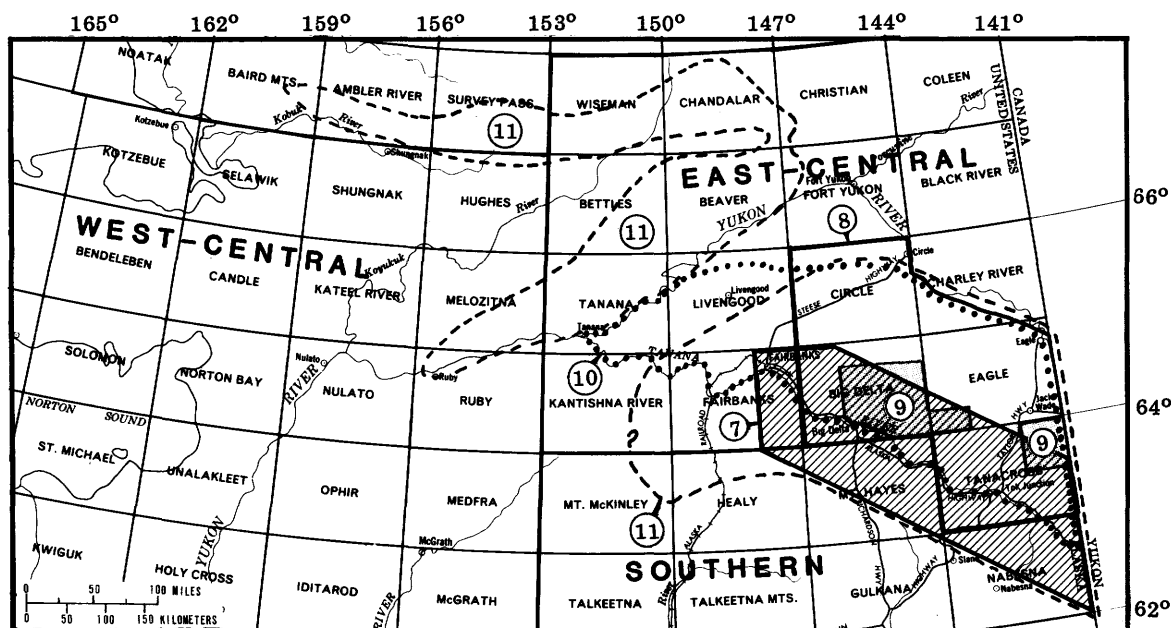
Geologic problems and key areas, critical to regional interpretations and the evaluation of mineral potential in central Alaska, have been recognized as a result of the recent mapping in the Ruby province. Several topical studies in selected areas are proposed to obtain additional pertinent data. In 1981, tectonostratigraphic studies in the Tanana and Livengood quadrangles and a mineral-potential study in the Kantishna River quadrangle were begun in collaboration with studies directed by D. L. Jones and B. L. Reed respectively. Similar research is planned for 1982, dependent on funding.

The project locations are shown in figure 18.



**EXPLANATION**

1. Yukon-Koyukuk Transect
2. Geology and Resources of Norton Sound-Yukon Region
3. Arctic Mineral Resources
4. Quaternary History of Climate and Regional Palynostratigraphy
5. Mafic-Ultramafic Igneous Complexes
6. College Observatory

**EXPLANATION**

7. Tanana Valley Transportation-Development Corridor
8. Yukon-Tanana Upland and Circle Quadrangle Studies
9. Petrographic Studies, Yukon-Tanana Upland
10. Glacial Geology of Yukon-Tanana Upland
11. Metamorphic Terranes of Central Alaska

Figure 18.--Geologic Division activities in west-central and east-central Alaska.

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Project Title: Mafic-ultramafic Igneous Complexes of Alaska (AMRAP)

Chief: Robert A. Loney

Objectives: To study mafic-ultramafic igneous bodies in Alaska, with special emphasis on those that are part of or fragments of ophiolite complexes. The chemistry, structure, and petrography of the rocks are studied in order to evaluate their economic potential (chrome, nickel, platinum, and copper) and tectonic significance. Work involves both reconnaissance mapping and sampling of bodies and adjacent terranes and detailed studies of critical areas.

Status: Initial and incomplete reconnaissance mapping of ultramafic ophiolite bodies in the Yuki River area (Nulato quadrangle) and the Mount Hurst body (Ophir quadrangle) was done in the summer of 1981. Petrographic studies of specimens is under way, and a preliminary report on mapping is in review. In 1982, the field reconnaissance of the areas will be completed, and work will begin of mafic-ultramafic rocks in the Kanuti River area (Bettles quadrangle). This new work will involve 1-inch-to-1-mile-scale mapping, as well as reconnaissance. Reports will be prepared as the work progresses. The project work interfaces with projects directed by W. W. Patton, Jr., and R. M. Chapman.

The quadrangles being studied and the areas of related work are shown in figure 18.

Project Title: Bendeleben and Solomon Quadrangles (AMRAP)

Chief: Alison Till

Objectives: (1) To assess the mineral potential of the central Seward Peninsula by means of geologic mapping, geochemical sampling, geophysical sampling, and geophysical reconnaissance; mapping and related studies on a scale of 1:250,000 will be supplemented by larger scale detailed mapping of areas critical to understanding the mineralization, geologic relationships, and regional geologic history. (2) To decipher the metamorphic and tectonic history of the region in order to establish the basis for assessment. (3) To interpret data pertinent to regional correlation and tectonic interpretation in order to relate the geology and mineral potential of the Seward Peninsula to adjacent terranes in the Brooks Range and the Chukotsk Peninsula of Siberia.

Status: Project work was initiated in 1981 with detailed mapping of selected orthogneiss bodies and sampling for geochemical analysis and radiometric dating. Geochemical reconnaissance of the Solomon quadrangle was completed in 1981. The 1982 field season will be the first full season dedicated to the project. Initial work will focus on deciphering and documenting the metamorphic stratigraphy and determining the relationship of some types of mineral deposits to that stratigraphy. Also in 1982, studies to determine the age of placer gold deposits

and the processes responsible for their formation will be started.

The project location is shown in figure 14.

Project Title: AMRAP Geochemistry, Solomon and Bendeleben Quadrangles, Seward Peninsula

Chief: Harley D. King

Objective: To contribute to the mineral-resource assessment of the Solomon and Bendeleben quadrangles. Information and interpretation will be based on results of reconnaissance geochemical sampling of streams, with sample media consisting primarily of stream sediment and heavy-mineral concentrates of stream sediment. Resulting interpretive geochemical maps will aid in outlining both known and previously unknown mineralized areas of possible economic potential.

Status: Project fieldwork was begun in 1981 and will continue in 1982; completion is planned for the summer of 1983. During the 1981 field season, reconnaissance geochemical sampling was done throughout the Kigluaik, Bendeleben, and Darby Mountains and in the area between the Darby Mountains and the Casadepaga River.

The quadrangles' location is shown in figure 14.

### EAST-CENTRAL REGION

Project Title: College Observatory, Fairbanks

Chief: John B. Townshend

Objectives: To produce accurate and comprehensive data in the fields of geomagnetism and seismology and to cooperate with other scientists and organizations in making studies within the capabilities of the personnel and facilities.

Status: The College Observatory has been in continuous operation since January 1948 and under USGS authority since September 16, 1973. Its present functions include recording of all components of the Earth's magnetic field by means of various types of magnetographs, magnetometers, and other scientific instruments including: Normal Magnetograph (D, H, Z), Storm Magnetograph (D, H, Z), Rapid Run Magnetograph (D, H, Z), Digital and Analog Fluxgate Magnetometer (D, H, Z), and Digital and Analog Proton Magnetometer (F). The observatory also makes absolute and scale value observations that serve as baseline control for recording equipment and quality control for data. It operates the Barrow Observatory at the Naval Arctic Research Laboratory at Barrow and publishes a monthly "Preliminary Geomagnetic Data" Geological Survey open-file report for use by scientists in Europe, Canada, Japan, and the United States. The observatory also operates and maintains various types of seismographs for recording earth motion as follows: Short Period World Wide Standardized Seismograph (N, E, V), Long Period World Wide Standardized Seismograph (N, E, V), and Benioff Moving Coil Seismograph. It analyzes records and makes investigations and studies associated with

geomagnetism and seismology; performs experimental work on improvement and development of magnetic and seismic instrumentation; cooperates with organizations in making studies and observations; provides information and data to the public concerning Alaska earthquakes and geomagnetic events; and operates a local climatological station in cooperation with the National Weather Service.

The observatory's location, Fairbanks, is shown in figure 18.

**Project Title:** Tanana Valley Transportation-Development Corridor: Fairbanks to the Canadian Border (Arctic Environmental Studies Program)

**Chief:** L. David Carter

**Objectives:** To compile a map showing the distribution of unconsolidated surficial deposits in the transportation-development corridor that extends southeastward up the Tanana River valley from Fairbanks to the Canadian border. Tables accompanying the map will include a description of lithology, topography, and geologic hazards in terms of the map units. Fieldwork includes geologic mapping at a scale of 1:125,000 in parts of Fairbanks, Big Delta, Mount Hayes, Tanacross, and Nabesna quadrangles.

**Status:** Existing geologic mapping has been compiled at a scale of 1:125,000. A description and interpretation of Tertiary tillites(?) on Granite Mountain was published in Alaska Division of Geological and Geophysical Surveys Geologic Report 63, and a map of the surficial deposits of the project area is in preparation.

The project location is shown in figure 18.

**Project Title:** Yukon-Tanana Upland and Circle Quadrangle (AMRAP)

**Chief:** Helen L. Foster

**Objectives:** To carry on geologic reconnaissance mapping of the complex metamorphic and igneous terrane of the Yukon-Tanana Upland primarily at a scale of 1:250,000, and to decipher and interpret the geologic history of the area and relate it to the structural history of other parts of Alaska and Canada. This information, along with geophysical, geochemical, and other data, will be used in evaluating the area's mineral-resource potential. Major geologic problems of the area will be identified and worked on as time and funding permit. Areas of special interest will be mapped at a scale of 1:63,360.

**Status:** Reconnaissance geologic maps (1:250,000-scale) have been published for the Tanacross (1970), Eagle (1976), and Big Delta (1978) quadrangles of the Yukon-Tanana Upland, and geochemical and mineral-resource information has been made available for these quadrangles. Reconnaissance geologic mapping of the Circle quadrangle has been completed, and a geologic map 1:250,000-scale will be put on open file in 1982. Geochemical,

geophysical, and mineral resource data are also being prepared for publication. Additional radiometric dating of both igneous and metamorphic rocks by potassium-argon and lead-uranium methods is being carried out and reported upon as completed. Study of the petrology of the metamorphic rocks continues. Limited field study of the metamorphic rocks of the southern part of the Charley River quadrangle is planned for the 1982 field season. Richard B. Tripp has carried out geochemical studies in the Circle quadrangle as part of AMRAP.

The project quadrangles are shown in figure 18.

**Project Title:** Petrographic Studies--Yukon-Tanana Upland

**Chief:** Cynthia Dusel-Bacon

**Objectives:** To obtain information about the origin, age, and metamorphic history of selected rock types in the crystalline terrane of the Yukon-Tanana Upland. Mineral parageneses, metamorphic and relict textures, mineral and bulk chemistry, isotopic data, and field relations will be used to formulate conclusions about the geologic history of these rocks. Chosen for study thus far are a large body of augen gneiss, a sillimanite gneiss dome (both approximately 700 square kilometers), and amphibolite layers in the Big Delta quadrangle.

**Status:** Preliminary reconnaissance mapping on which these studies largely are based was completed under AMRAP. Additional sampling of rocks (for chemical analysis and radiometric dating) and field checking was done during a total of about 2 weeks in 1979-81. Petrographic description of these rocks, as well as of all the samples collected during mapping of the Big Delta quadrangle for AMRAP, has been completed. A manuscript describing the petrology and garnet-biotite geothermometry of the sillimanite gneiss dome has been submitted for publication as a Survey Professional Paper. Some of the results of the augen gneiss study and related uranium-thorium-lead (U-Th-Pb) geochronologic investigations of zircons from the augen gneiss and related rocks have been published. Papers discussing the geochemistry of the augen gneiss, late-stage sills, and ortho-amphibolite, and a paper giving additional U-Th-Pb and rubidium-strontium data and a more comprehensive geochronologic discussion of the Yukon-Tanana Upland are in progress. Further work will focus on similar study of amphibolites and other areas of augen gneiss in other parts of the upland.

The project location is shown in figure 18.

**Project Title:** Glacial Geology of the Yukon-Tanana Upland (Geologic Framework and Synthesis Program)

**Chief:** Florence R. Weber

**Objectives:** To obtain information in order to compile: (1) a map of glacial deposits of the Yukon-Tanana Upland; (2) correlated stratigraphic sections of the glacial deposits; and, (3) interpretations of glacial history of the upland as it relates

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to glacial deposits in the Brooks and Alaska Ranges. An understanding of the glacial history bears on the origin of gold placer deposits and the development of cropland or transportation corridors.

Status: Photogeologic assessment has been partly completed for the Eagle, Big Delta, Circle, Livengood, and Charley River quadrangles. Field checking continued during the summer of 1981, and samples were collected for pollen analysis. Carbon-14 dates were obtained from samples collected previously.

A Pleistocene fossil vertebrate locality has been described in an article by Weber and others in the *Journal of Quaternary Research* (v. 16), and a paper on the glacial geology of the Mount Prindle area is under way.

The project location is shown in figure 18.

Project Title: Metamorphic Terranes of Central Alaska Applied to Regional Tectonic Reconstruction

Chief: James H. Dover

Objectives: To compare and contrast the Yukon-Tanana, Ruby-Rampart, and South Flank Brooks Range metamorphic belts with one another in a regional tectonic and paleogeographic context. To be considered in the evaluation of each terrane are: (1) stratigraphic character and age of protolith; (2) internal structural configuration, style, and sequence; (3) metamorphic character, history, and origin, and interaction of metamorphic crystallization with structural development; and (4) structural character of terrane boundaries.

Status: Initial reconnaissance begun in 1981 will continue in the Yukon-Tanana belt for purposes of rock sampling and of identifying representative areas for detailed follow-up mapping at intermediate scales. Representative areas will be those identified from existing or new reconnaissance mapping to contain: (1) critical geologic relations, (2) possibilities for stratigraphic subdivision or dating of petrologic units, (3) potential for identifying and relating major and minor structures, and (4) adequate exposure. Mapping at a scale of 1:63,360 will be started in a traverse across the Ray Mountain part of the Ruby-Rampart metamorphic belt, with emphasis on comparing internal metamorphic and structural development with that in the ophiolite sheets and zones of major structural dislocation bounding the belt.

The project location is shown in figure 18. The western margin of the Yukon-Tanana part of the study area is indefinite at this time.

Project Title: Wiseman Quadrangle (AMRAP)

Chief: William P. Brosge

Objectives: To produce a new reconnaissance geologic map for a mineral-resource assessment of the Wiseman quadrangle. The project is in informal cooperation with the Alaska Division of Geological

and Geophysical Surveys (DGGGS) and will draw upon previous geologic and geochemical studies made in the area by the DGGGS and the Geological Survey and upon continuing detailed geologic mapping by John T. Dillon (DGGGS) and geochemical investigations directed by John B. Cathrall (U.S. Geological Survey).

Status: Open-File Report 71-56 (map) is being revised from new mapping by the DGGGS at a scale of 1:63,360 in the southern part of the quadrangle and by the Survey at a scale of 1:250,000 in the northern part. Almost all of the new mapping in the western two-thirds of the quadrangle has been completed, mostly by the DGGGS in 1977-1979, the rest by joint effort of the Geological Survey and DGGGS in 1980. Geologic maps of the A-3 and A-4 quadrangles have been published as DGGGS Open-File Reports AOF 119 and 124, and ten more are in preparation. In addition, the DGGGS has published geochemical maps of the southwestern third of the quadrangle (AOF 133A and 133B). Joint fieldwork by the Geological Survey and DGGGS in 1982 should complete the mapping in the eastern part of the quadrangle.

The quadrangle location is shown in figure 14.

Project Title: Mineral Resources of the Wiseman Quadrangle, Brooks Range (AMRAP)

Chief: John B. Cathrall

Objectives: To assess and appraise the mineral-resource potential of the Wiseman (1:250,000-scale) quadrangle. To accomplish this, drainage systems, geologic rock units, fault zones, altered and/or mineralized zones, and favorable host rock will be sampled, and the geochemical results will be used in geostatistical programs and integrated with the results of the studies of geologic, geochemical, and economic geologic environments of the area, as well as of Landsat imagery. Maps will be prepared and interpreted, and the integrated conclusions will be prepared for publication as a series of maps and short reports.

Status: The 1981 field season was the first for this project. About 600 panned-concentrate samples, 600 stream-sediment samples, and 250 stream pebble samples have been collected. The analytical results from these sample media will be merged with the data collected by various State and Federal agencies over the past several years.

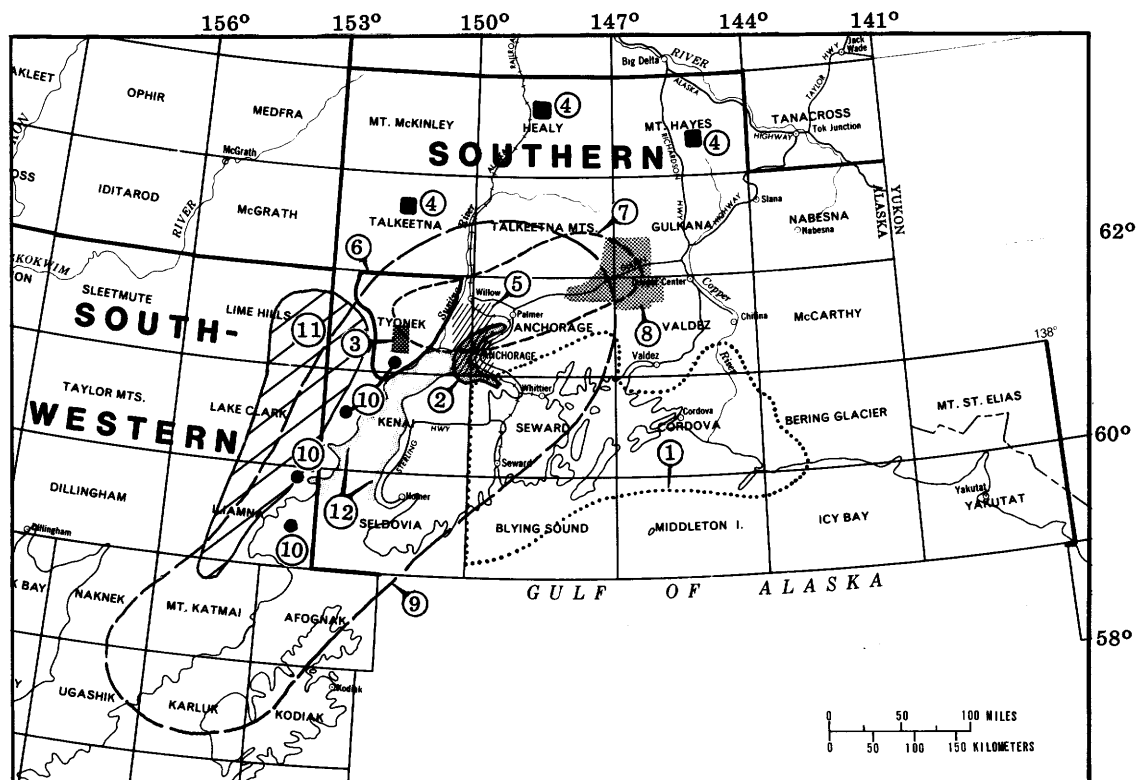
The quadrangle location is shown in figure 14.

## SOUTHERN REGION

Project Title: Chugach National Forest Wilderness Study (RARE II)

Chief: Steven W. Nelson

Objectives: (1) To complete a multidisciplinary mineral appraisal of land in the Chugach National Forest that has been allocated for further planning under RARE II, and (2) to integrate detailed and



#### EXPLANATION

1. Chugach National Forest (RARE II)
2. Alaska Coastal Environments, Turnagain and Knik Arms
3. Element Availability, Plants and Soils
4. Alaska Range Coal Resources
5. Earthquake Hazards Mapping
6. Regional Engineering Geology of Cook Inlet Coal Lands
7. Nelchina Area Stratigraphic Studies
8. Southwestern Copper River Basin Surficial Geology Studies
9. Petroleum Geology, Cook Inlet-Shelikof Strait
10. Volcanic Hazards of Cook Inlet
11. Alaska-Aleutian Range Batholith
12. Quaternary Climate History and Tephrochronology

Figure 19.--Geologic Division activities in southern Alaska.

reconnaissance geologic field mapping with regional and topical investigations of geochemistry, geophysics, economic geology, and mineral economics to produce a mineral-resource assessment of the study area.

**Status:** Reconnaissance geologic mapping was started in FY 1980 and is about 60 percent complete. Geochemical sampling is about 60 percent complete. Microfossil collections from five areas within the study area confirm the Tertiary age of the Orca Group sedimentary rocks. Previously unknown molybdenite occurrences were examined in the Seward and Cordova quadrangles. Their economic significance is presently being evaluated.

Approximately 2 million acres were added to the project area with the passage of the Alaska National

Interest Lands Conservation Act in December 1980. Much of the FY 1981 fieldwork was concentrated in these new areas. Fieldwork will continue in FY 1982.

The project location is shown in figure 19.

**Project Title:** Alaska Coastal Environments

**Chief:** Susan Bartsch-Winkler

**Objectives:** To provide needed baseline information on the sediment characteristics in the intertidal zones surrounding Anchorage, and to determine the factors which control sediment transport and deposition in these areas.

## GEOLOGIC

**Status:** The following field studies are complete: 1) Reconnaissance sampling and mapping of Turnagain and Knik Arms for texture, mineralogy, bedform, and internal sedimentary structures; 2) monitoring of the intertidal sediments at the head of Turnagain Arm, a deposit resulting from lowering of the land after the 1964 Alaska earthquake; 3) detailed process-response studies of a small plot near Girdwood; and 4) obtaining and analyzing approximately 100 meters of core from the Portage area.

No fieldwork will be conducted in 1982. Final reports are in preparation.

The project location is shown in figure 19.

**Project Title:** Element Availability - Plants; Element Availability - Soils

**Chiefs:** Larry P. Gough (plants) and Ronald C. Severson (soils)

**Objectives:** To establish principles for predicting element concentrations in plants from the element concentrations of extracts of native and disturbed soils. The Capps coal field of the Beluga coal area is one of several sites covered by the cooperative efforts of these two projects. For this study area, background geochemical information on native plants and soils will be obtained prior to mining in order to provide geochemical data on the natural, undisturbed landscape. These data will be used as geochemical base lines to which changes reflecting surface mining (and the activities associated with coal extraction in general) can be compared. Information about the natural landscape will also be beneficial to those concerned with the rehabilitation potential of native soils and plants.

**Status:** The study area consists of sections 22, 23, 26, and 27 of T. 14 N, R. 14 W in the Tyonek B-5 quadrangle, where several of the proposed coal strip mine sites are located. Nine study sites in each section were randomly selected according to an analysis-of-variance study design. At each site, channel samples of the soil most likely to be used in land rehabilitation were taken, along with specimens of diamondleaf willow (*Salix pulchra*), bluejoint grass (*Calamagrostis canadensis*), and fescue (*Festuca altissima*). The study design will make it possible to map the concentration of elements in the materials sampled. Because the design is balanced through the 0.25-kilometer level, maps of individual elements in samples on a 250-meter grid may be possible. Future alterations in landscape geochemistry can, therefore, be relatively easily monitored. At the end of the 1981 field season all 108 of the randomly located sites had been sampled. Laboratory analytical data should be received and report writing begun by the end of FY 1982.

The project location is shown in figure 19.

**Project Title:** Alaska Range Coal Resources

**Chief:** Clyde Wahrhaftig

**Objectives:** (1) To evaluate late Cenozoic con-

tinental formations in and on the flanks of the Alaska Range, specifically the Nenana coal area in the Healy quadrangle, the Jarvis Creek coal area in the Mount Hayes quadrangle, and the Peters Hills field west of Talkeetna. (2) To study the Cenozoic history of the central Alaska Range.

**Status:** Two reports are in preparation. The topics are: Geology of the coal deposits in the Nenana coal field, the illustrations for which have been released as Open-File Report 73-355; and a late Cenozoic orogeny in the Alaska Range and the history of the Nenana Gravel.

The project location is shown in figure 19.

**Project Title:** Earthquake Hazards Mapping, Anchorage-Susitna Lowlands (Earthquake Hazards Reduction Program)

**Chief:** Oscar J. Ferrians, Jr.

**Objectives:** To complete mapping of earthquake hazards in the region, with emphasis on assessing the response of surficial materials to earthquakes. The Anchorage-Susitna Lowlands, which is in an extremely active seismic zone, will experience the greatest development and population growth of any region in Alaska. As a means of providing the information needed for planning and development, an investigation of this earthquake-prone region is being undertaken to obtain the critical data necessary for identification and evaluation of earthquake hazards.

**Status:** This project will be completed by the end of calendar year 1982.

The project location is shown in figure 19.

**Project Title:** Regional Engineering Geology of Cook Inlet Coal Lands

**Chiefs:** Henry R. Schmoll and Lynn A. Yehle

**Objectives:** To investigate the nature, location, and extent of general environmental concerns and potential problems caused by response of geologic materials (surficial deposits and bedrock) to surface mining of coal, facility siting, and accompanying land utilization for associated development (including transportation routes and urban development) in the Cook Inlet region.

**Status:** To date, most effort has been devoted to a study of the Capps Glacier-Tyonek area about 100 kilometers west of Anchorage, where strip mining of coal is anticipated within the next several years. Field investigations, comprising helicopter, fixed-wing aircraft, land vehicle, and foot traverses, are presently in progress within the area of about five 1:63,360-scale quadrangles and will continue into adjacent quadrangles covering potential transportation corridors. Maps of surficial geology are compiled chiefly from aerial photographs and checked in the field. Physical properties of Tertiary sedimentary rocks and Quaternary surficial deposits are being determined in the laboratory

from samples collected from outcrops and from three test holes in the proposed Capps and Chuitna West coal mining areas. Stratigraphic work in progress includes studies of late Tertiary to early Quaternary volcanic and glacial diamictite and of Holocene tephra.

The project location is shown in figure 19.

Project Title: Nelchina Area Stratigraphic Studies

Chiefs: Arthur Grantz

Objectives: To study the structure, stratigraphy, and tectonic development of the Mesozoic and Tertiary rocks of the Nelchina area, Matanuska Valley, and upper Cook Inlet regions.

Status: Geologic mapping at a scale of 1:63,360 of the Nelchina area is complete, and preliminary geologic maps have been published. Final maps are in preparation. Field stratigraphic studies of the bedded rocks and potassium-argon dating of the igneous rocks of the Nelchina area, Matanuska Valley, and upper Cook Inlet are underway. A report on the Arkose Ridge Formation is in preparation.

The project location is shown in figure 19.

Project Title: Southwestern Copper River Basin (Surficial Deposits) (Arctic Environmental Studies Program)

Chief: John R. Williams

Objectives: To provide a map at a scale of 1:125,000 of the surficial deposits of the Copper River basin and bordering parts of the Talkeetna and Chugach Mountains between the Matanuska Glacier at Mile 100, Glenn Highway, and Tolsona Creek at Mile 170, northward to the latitude of the north end of Susitna Lake. Discussions of the glacial history, relation between late Wisconsinan glaciation and glacial lakes, and radiocarbon dating of the deposits will be included or prepared as separate reports.

Status: The project was begun with fieldwork in 1952-57 in cooperation with the Office of the Chief of Engineers, U.S. Army, and has resulted in reports of special interest to the cooperator. It was continued in 1978-80 as part of AMRAP and the Arctic Environmental Studies Program with work in the Valdez quadrangle, in the Talkeetna Mountains, and adjacent parts of the basin. The final map report, at a scale of 1:125,000, is approximately 35 percent complete, and office work will continue in 1982 on a time-available basis.

The project location is shown in figure 19.

Project Title: Petroleum Geology, Cook Inlet-Shelikof Strait

Chief: Leslie B. Magoon

Objectives: (1) To study and report on the upper

Mesozoic, Tertiary, and reservoir rocks penetrated in the lower Cook Inlet COST well 1, and (2) to study and report on key stratigraphic sections adjacent to the Shelikof Strait from Puale Bay to Kamishak Bay. The long-range objective is to provide data and interpretations necessary to assess the oil and gas potential of possible hydrocarbon sources and reservoir horizons in the Cook Inlet-Shelikof Strait area.

Status: During FY 1982 a report on the COST well will be completed, as will petrographic analyses of sandstones from the Alaska Peninsula. A pre-Tertiary subcrop map and a present-day geothermal gradient map are in preparation.

The project location is shown in figure 19.

Project Title: Volcanic Hazards of Cook Inlet (Volcanic Hazards Program)

Chief: James R. Riehle

Objectives: To determine the eruptive history of the four historically active volcanoes of Cook Inlet (Augustine, Iliamna, Redoubt, and Spurr) and evaluate the hazards to life that eruptions would produce. Geologic mapping, geochemistry and geochronology, and regional tephra studies will be used to establish past volcanic activity; hazard assessments will be based in part on this information.

Status: Mapping of Mount Redoubt and adjacent river valleys was completed in 1981; hazards assessment and geochemical and petrographic studies are under way. Reconnaissance mapping of Mount Spurr was initiated in 1981 and will continue. Samples taken for a regional tephra study are being processed and will continue to be collected. A seismograph recording data telemetered from stations near Mount Iliamna, Mount Redoubt, and Mount Spurr has been installed at the Branch of Alaskan Geology offices at Gould Hall, Alaska Pacific University, in Anchorage; it is monitored daily for volcano-related seismic events.

The project location is shown in figure 19.

Project Title: Alaska-Aleutian Range Batholith (Geologic Framework and Synthesis Program)

Chief: Bruce L. Reed

Objectives: (1) To produce a geologic map of the central portion of the batholith. (2) To define the age, geochemistry, tectonic setting, and the spatial and temporal relations of the magmatic events and their relation to plate-tectonic theories of arc formation and generation of ore deposits. (3) To determine the chronology of emplacement, chemical character, polarity, and tectonic framework of an ancient, deeply dissected magmatic arc of Jurassic age on the eastern margin of the batholith. Examination of the deeper part of an ancient arc can provide chemical and physical data that are not available in the exposed upper parts of modern island arcs.

**Status:** Geologic mapping, sampling, and geochronologic studies on the eastern margin of the batholith between Tuxedni Bay and Chakachamna Lake were completed in 1981. Compilation of a geologic transect for this part of the batholith is in preparation. A topical paper on the geochronologic, chemical, and isotopic character of a trondhjemite-tonalite suite of rocks of Jurassic age is in preparation. In 1982 geologic mapping, sampling, and geochronologic studies of the northeasternmost part of the batholith (the Tordrillo Mountains, north of Chakachamna Lake and east of the Skwentna River, about 1,600 square miles) will be initiated.

The project location is shown in figure 19.

**Project Title:** Quaternary Climate History and Tephrochronology, South-Central Alaska (Climate Change Program)

**Chief:** Thomas A. Ager

**Objectives:** To reconstruct the history of vegetation, limnological conditions, and climate of the Cook Inlet region since the onset of deglaciation about 14,000 years ago by means of pollen, ostracode, and diatom analysis of lacustrine sediments. A secondary objective is to define the regional tephrochronology by means of radiocarbon dated tephra obtained from sediment cores.

**Status:** The main fieldwork for this project will be carried out in June and July 1982. Data analysis will follow.

The project location is shown in figure 19.

**Project Title:** Healy Quadrangle (AMRAP)

**Chief:** Béla Csejtey, Jr.

**Objectives:** To assess the mineral potential of the Healy quadrangle through reconnaissance geologic, geochemical, and geophysical investigations, and to collect basic geologic data to help decipher the complex tectonic and igneous history of southern Alaska.

**Status:** Geologic and geochemical investigations in the quadrangle are about 90 percent complete. Only a few days of fieldwork are planned for the summer of 1982. The compilation and evaluation of geologic and geochemical data collected is presently under way.

The quadrangle location is shown in figure 14.

**Project Title:** AMRAP Geochemistry, Healy Quadrangle

**Chief:** Harley D. King

**Objectives:** To produce geochemical maps useful in the assessment of the mineral potential of the Healy quadrangle. The objectives are to be accomplished by reconnaissance geochemical sampling of stream sediments and heavy-mineral (panned) concentrates

of stream sediments. The geochemical maps will show the distribution and concentration of selected metallic elements in the sample media.

**Status:** Geochemical sampling was begun in 1980, continued in 1981, and is planned for completion with about 2 weeks fieldwork in 1982. Publication of results will be coordinated with those of geologic studies directed by Béla Csejtey, Jr.

The quadrangle location is shown in figure 14.

**Project Title:** Mount Hayes Quadrangle (AMRAP)

**Chief:** Warren J. Nokleberg

**Objectives:** To conduct reconnaissance and detailed geologic mapping and geochemical and geophysical surveys to provide data for a mineral-resource assessment of the Mount Hayes quadrangle. Fieldwork includes: (1) geologic mapping at scales of 1:250,000 to 1:120,000; (2) detailed studies and sampling of mineralized areas; (3) isotopic studies of bedrock and mineralized rocks; (4) interpretation of aeromagnetic surveys; (5) mapping and sampling of placer deposits; and (6) studies of surficial deposits.

**Status:** Geologic mapping, bedrock sampling, and sampling of stream sediments and heavy-mineral concentrates are complete for the entire quadrangle. Various reports for the quadrangle folio are in preparation. A 21-day field season is planned for 1982 with a team of about six people. Fieldwork will concentrate on specific mineral deposits throughout the quadrangle.

Related geochemical studies are being conducted by Richard B. Tripp.

The quadrangle location is shown in figure 14.

**Project Title:** Anchorage Quadrangle (AMRAP)

**Chief:** Gary R. Winkler

**Objectives:** (1) To assess the mineral potential of the Anchorage quadrangle through integration of existing information and through new reconnaissance and detailed geologic, geochemical, geophysical, and geochronological investigations; (2) to continue detailed geologic and radiometric studies of the Willow Creek mining district; and (3) to continue detailed stratigraphic, paleontologic, or petrologic studies of Mesozoic bedded rocks in the Talkeetna and Chugach Mountains.

**Status:** Considerable published and unpublished geologic information has been generated through previous Federal, State, and academic studies in parts of the quadrangle. A 30-day field season is planned for the summer of 1982 in order to complete field investigations for the entire quadrangle.

The quadrangle location is shown in figure 14.

**Project Title:** Geochemical Studies for the Peters-



burg and Anchorage AMRAP Quadrangles and Chugach (RARE II) Project).

Chief: James D. Hoffman

Objectives: To provide geochemical analyses and support for the Petersburg, Anchorage AMRAP, and wilderness-area studies.

Status: Sampling and analysis in support of the AMRAP Anchorage quadrangle project began during the summer of 1981. This work is also being done in conjunction with the Chugach (RARE II) wilderness study, which involves an area immediately to the east. Stream-sediment and heavy-mineral-concentrate sampling for the Petersburg project is complete; analysis of these samples was concluded by late 1981. Some additional bedrock samples from this quadrangle may be collected in FY 1982. (See D. A. Brew, Petersburg 1:250,000-scale quadrangle project, southeastern region).

The areas in which project work takes place are shown in figures 14 and 19.

Project Title: Alaska Seismic Studies (Earthquake Hazards Reduction Program)

Chief: John C. Lahr

Objectives: To understand those tectonic processes that generate Alaskan earthquakes, and thereby to evaluate the earthquake hazards that threaten present and future development. Of particular importance is the search for premonitory phenomena and physical conditions prior to moderate and large earthquakes.

Status: Seismic data are collected and analyzed from a network of 54 high-gain telemetered stations and 25 strong-motion instruments located at sites extending across southern Alaska from the western shore of Cook Inlet to Juneau and north to the Talkeetna Mountains. Five stations around the proposed Bradley Lake Hydroelectric Project site are operated in a cooperative study with the Corps of Engineers. Three stations near Spurr, Redoubt, and Iliamna volcanoes west of Cook Inlet are supported by the Geological Survey's Volcano Hazards Program. Study emphasis is being placed on monitoring the seismicity in the Yakataga seismic gap, a region that is thought to be a likely site for a future major earthquake. The possible significance of elevated levels of seismicity in this region between October 1980 and May 1981 is being weighed.

Locations of high-gain seismic instruments and Yakataga seismic gap are shown in figure 20.

Project Title: Tilt Operations in the Yakataga Seismic Gap (Earthquake Hazards Reduction Program)

Chief: Carl E. Mortensen

Objective: To monitor crustal deformation associated with strain accumulation prior to earthquakes

in the Yakataga seismic gap.

Status: The project investigators continued to operate a tiltmeter array in Alaska that consists of doubly instrumented sites at Cape Yakataga, Yakutat, and Icy Bay. Data analysis continues. Data are transmitted to Menlo Park, Calif., via the GOES satellite.

Some results of the project's work at Cape Yakataga area have been published in the Bulletin of the Seismological Society of America (v. 70, no. 5, October 1980).

The project area is shown in figure 20.

Project Title: Crustal Strain in the Yakataga and Shumagin Island Seismic Gaps

Chiefs: James C. Savage and Will H. Prescott

Objective: To measure strain accumulation in the Yakataga and Shumagin Islands seismic gaps.

Status: A trilateration network of 38 lines located on the Shumagin Islands was measured in 1980 and 1981. The network spans an area 30 kilometers wide along the Pacific plate boundary and covers the region between 150 and 250 kilometers northwest of the Aleutian trench along which subduction of the plate occurs. The network has 18 angles in common with a 1913 third-order triangulation survey. Twenty-two of the length measurements made in 1980 were repeated in 1981. Comparison of observations over the 1913-80 time period gave shear strain rates with a standard deviation of 0.10  $\mu$ strain/year (engineering). The 1954-80 comparison had a standard deviation of 0.10  $\mu$ strain/year, and the 1980-81 comparison 0.20  $\mu$ strain/year. The increased precision of the newer observations is offset by the shorter time periods. The only significant strain rate observed was for the period 1954-80. Over this time period, T1 (which measures left-lateral shear parallel to the northeast-striking plate boundary) changed at a rate  $-0.25 \pm 0.10$   $\mu$ strain/year, indicating a right-lateral component of slip on the thrust fault. Compression or extension normal to the plate boundary would be reflected in T2 which had a rate of  $0.10 \pm 0.13$   $\mu$ strain/year during the period 1954-80, not significantly different from zero. Comparisons for other time periods indicated that the strain rates are below the noise level in the observations.

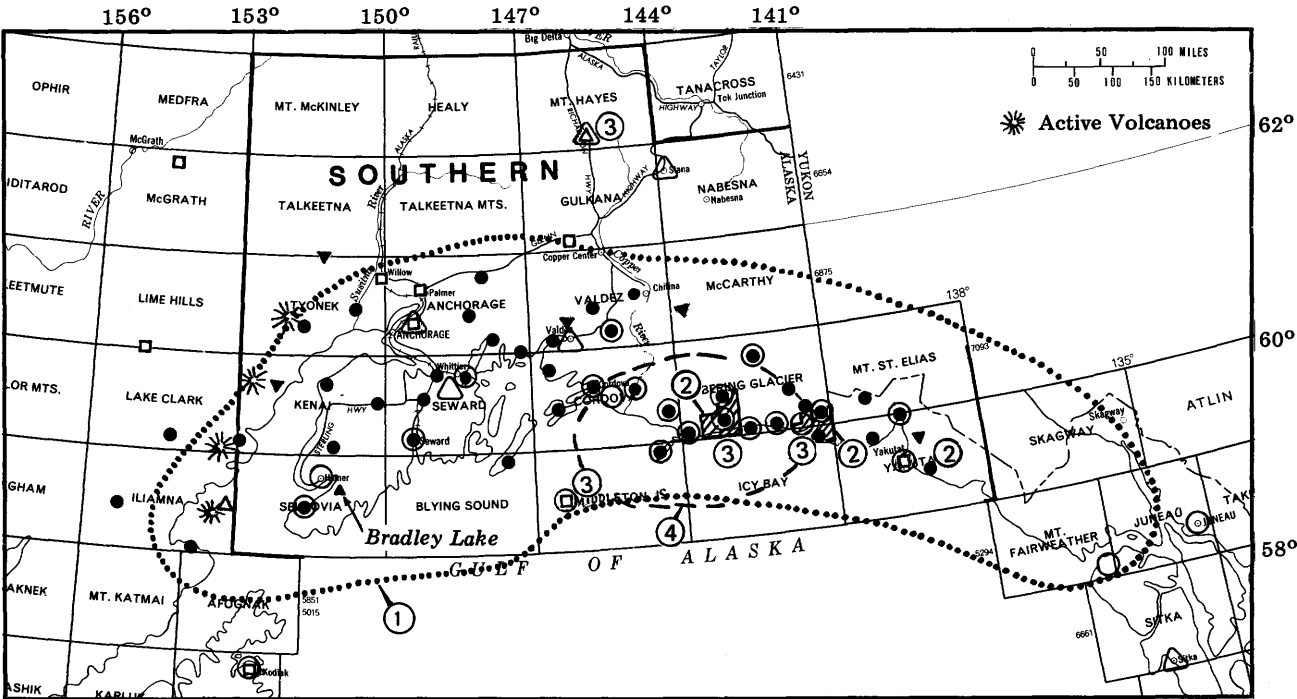
Portions of a trilateration network of 25 lines, located near Cape Yakataga, were surveyed in 1979 and 1980. Results of this work were reported in the 1981 Alaska Program Circular. Another survey of this network is planned for the 1982 field season.

The project location is shown in figure 20.

Project Title: Seismicity and Earthquake Source Properties in the Yakataga Seismic Gap (Earthquake Hazards Reduction Program)

Chief: Robert A. Page

GEOLOGIC



EXPLANATION

1. Seismic Studies

Sensitive Seismographs

- USGS Vertical Component
- ▼ USGS 3 Component
- NOAA
- △ University of Alaska

Strong Motion Instruments

- OCSEAP Support
- △ USGS Support

2. Tilt Operations

- 3. Crustal Strain Study (Shumagin Islands study area not shown)
- 4. Yakataga Seismic Gap

Figure 20.--Geologic Division earthquake and seismic studies in southern Alaska.

**Objectives:** (1) To construct a reliable earthquake history of the study area; (2) to refine the seismo-tectonic model and define the rupture surface(s) for a gap-filling earthquake; (3) to examine patterns of seismicity through time to reassess forecasts for a gap-filling earthquake; and (4) to search for changes in the seismic characteristics of the region that might aid in predicting a major earthquake.

**Status:** The project is in its second year. Effort is continuing to complete the routine location of earthquakes recorded by the Survey's southern Alaska seismograph network since 1974 and to precisely relocate large historic earthquakes using special analysis techniques. A generalized three-dimensional model of the P-wave velocity of the crust and upper mantle beneath the study area is being determined from the arrival times of P-waves recorded from distant large earthquakes. The first reports from this project are expected in 1982.

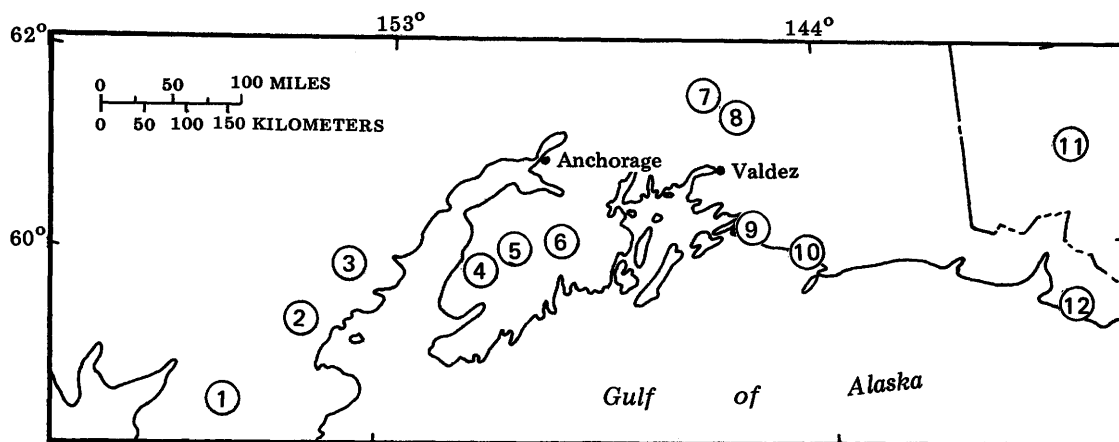
The project location is shown in figure 20.

**Project Title:** Tectonic Tilt Measurements Using Lake Levels, Intermountain Seismic Belt and Southern Alaska (Earthquake Hazards Reduction Program)

**Chief:** Spencer H. Wood

**Objective:** To monitor tectonic tilt in areas that have a potential for large to moderate earthquakes.

**Status:** Water levels in Iliamna, Naknek, Kontrashibuna, Kenai, Skilak, Tustumena, Tazlina, Klutina, Eyak, and Bering Lakes in Alaska and Kluane Lake in Yukon Territory were measured in 1964, 1966, and 1979. Harlequin Lake in south-eastern Alaska was added to the study in 1980. Results of the study indicate that records of lake levels will not easily detect small land-surface tilt that develops over periods of several months to a year, but that small tilt rates over several years may be resolved. No measurements were made in 1981, but the array will be remeasured in 1982.

**EXPLANATION**

- |                       |                    |
|-----------------------|--------------------|
| 1. Naknek Lake        | 7. Tazlina Lake    |
| 2. Iliamna Lake       | 8. Klutina Lake    |
| 3. Kontrashibuna Lake | 9. Eyak Lake       |
| 4. Tustumena Lake     | 10. Bering Lake    |
| 5. Skilak Lake        | 11. Kluane Lake    |
| 6. Kenai Lake         | 12. Harlequin Lake |

Figure 21.--Large lakes in southern Alaska and Yukon Territory used to monitor tectonic tilt.

Significant tilt on Kenai Lake has been determined; results are reported in abstract in "Earthquake News", v. 52, no. 1, p. 26.

The project location is shown in figure 21.

**SOUTHWESTERN REGION**

**Project Title:** Mineral Resource Assessment of the Ugashik-Karluk Quadrangles (AMRAP)

**Chief:** Robert L. Detterman

**Objectives:** To appraise the mineral and energy potential of the northern part of the Alaska Peninsula, and to provide reliable geologic estimates of these resources based on geologic, geochemical, geophysical, and telegeologic mapping. Project activities include mapping the entire area at a scale of 1:250,000 and selected and critical areas at a scale of 1:63,360; obtaining stream-sediment and pan-concentrate samples from all major streams; to determine the age of mineralization of mineralized and altered areas by potassium-argon methods; a regional aeromagnetic and gravity study; and a geothermal study of the Quaternary volcanic centers.

**Status:** Field investigations in the quadrangles were completed in 1981. Sample analysis and map compilations are in progress and will result in a folio of geologic, geochemical, geochronologic, aeromagnetic, and mineral and energy resource maps with an accompanying circular. Project results to date include finding: several areas of anomalously high gold, silver, lead, zinc, and molybdenum mineralization by geochemical sampling; a previously unknown late Quaternary volcano; and Early Cretaceous (Albian) clastic rocks and Silurian

and Devonian carbonate rocks on the northern Alaska Peninsula. Geochemical studies that complement this work have been directed by David E. Detra, and publication of geochemical data is being coordinated with publications for this project.

The project quadrangles are shown in figure 14.

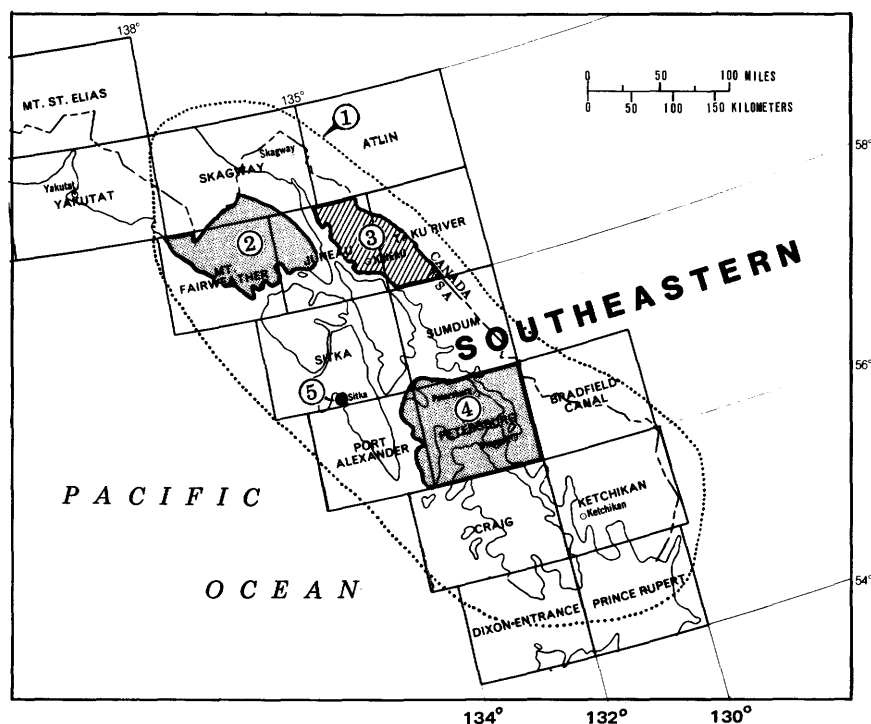
**SOUTHEASTERN REGION**

**Project Title:** Geotectonics, Metallogenesis, and Resource Appraisal of Southeastern Alaska

**Chief:** Henry C. Berg

**Objectives:** To furnish information on southeastern Alaska's regional mineral endowment and to provide reliable geologic estimates of its undiscovered mineral-resources. The project is a multidisciplinary mineral resource assessment of the southeastern panhandle that will integrate geology, geotectonics, geophysics, geochemistry, and economic geology. A new metallogenic province map incorporating current concepts of tectonostratigraphic (accreted) terranes will delineate areas that are geologically favorable for the occurrence of specific types of mineral deposits, will list the criteria used to establish these areas, and, when data permit, will include probabilistic numerical estimates of undiscovered deposits of specific types and of their contained tonnages and grades. The assessment will be published as a folio of 1:1,000,000-scale maps and accompanying tables.

**Status:** This project started in FY 1979. Since then, investigations and results have included: (1) compiling 1:1,000,000-scale geologic maps of the study area; (2) publishing preliminary aeromagnetic



#### EXPLANATION

1. Geotectonics, Metallogensis, and Resource Appraisal of Southeastern Alaska
2. Mineral Resources of Glacier Bay National Monument Wilderness Study Area
3. The Coast Plutonic Complex and Surroundings near Juneau
4. Mineral Resources and Geology of the Petersburg Quadrangle
5. Sitka Observatory

Figure 22. -- Geologic Division activities in southeastern Alaska.

contour and profile maps of southeastern Alaska (Open-File Reports 79-1694 and 81-0505); (3) publishing a description of Upper Triassic massive sulfide deposits near Petersburg (Open-File Report 80-527 and an article in Circular 823-B); (4) publishing a map and table describing mineral deposits in the Petersburg and eastern Port Alexander quadrangles (Open-File Report 80-793); (5) publishing a map and table describing metallic mineral deposits in southeastern Alaska (Open-File Report 81-0122); and (6) mapping and sampling selected types of mineral deposits and analyzing their tectonostratigraphic settings.

In addition, the following findings of economic interest have resulted from studies of mines and prospects in selected tectonostratigraphic terranes in southeastern Alaska: (1) discovery of stratiform, massive zinc(-lead) sulfide deposits on Zarembo and Kupreanof Islands (Admiralty terrane); (2) discovery of Late Triassic fossils in the stratiform, massive zinc sulfide deposit on Kupreanof Island; (3) discovery of probable Late Triassic fossils in metamorphic strata, previously considered to be Paleozoic, that host a barite deposit now being mined at Duncan Canal; and (4) preliminary

identification of a 300-kilometer-long Triassic metallogenic province in the study area containing volcanogenic massive zinc, lead, silver, copper, and gold deposits in metamorphosed Upper Triassic strata. This newly recognized province appears to be restricted to the Admiralty and Annette tectonostratigraphic terranes and is the first metallogenic province to be identified in southeastern Alaska by integrating mineral deposit data, biostratigraphy, and regional tectonostratigraphic concepts.

The project location is shown in figure 22.

**Project Title:** Mineral Resources of Glacier Bay National Monument Wilderness Study Area

**Chief:** David A. Brew

**Objectives:** To appraise the mineral-resource potential of a large area of complex geology just northwest of the Alexander Archipelago, using (1) reconnaissance geologic, geochemical, and detailed mineral-occurrence information gathered in the 1966 Geological Survey study of the monument (Professional Paper 632); (2) reconnaissance geologic

mapping of previously unmapped areas; (3) reconnaissance bedrock geochemical sampling; (4) reconnaissance stream-sediment geochemical sampling of previously unsampled areas; (5) aeromagnetic surveying; (6) gravity surveying; and (7) detailed examination and sampling of selected known mineral occurrences and of areas containing anomalous concentrations of selected metallic elements. The appraisal is part of the National Park Service study of the suitability of the areas for inclusion in the National Wilderness Preservation System established by the Wilderness Act of 1964.

**Status:** The reconnaissance geologic mapping is not satisfactorily complete. A bulletin report is in review; a map and a report on the intrusive rocks are in progress; and an analysis of the stream-sediment geochemistry of the southeastern part of the monument and contiguous areas is under way. The project is unfunded in FY 1982.

The project location is shown in figure 22.

**Project Title:** The Coast Plutonic Complex and Surroundings near Juneau (AMRAP)

**Chief:** David A. Brew

**Objectives:** To conduct reconnaissance and detailed geologic and geochemical mapping and a mineral-resource appraisal of a broad transect across the Coast plutonic complex. The transect extends from metavolcanic and metaclastic rocks of a low-grade, intermediate-pressure and -temperature facies series on the southwest through higher grade schists, gneisses, and spatially associated metavolcanic and metaclastic rocks of a low-pressure, high-temperature facies series near the United States-Canada boundary. This information will provide the regional framework for the Juneau gold belt and for mineral occurrences near the international border.

**Status:** Geologic mapping at 1:63,360 or larger scale has been completed for all but the easternmost and northwesternmost parts of the project area. Three 1:31,680-scale maps have been published, and four more are in progress. Several topical papers describing metamorphism, geochemistry of Mesozoic metavolcanic rocks, mineral resources, and structure have been published, and more are in progress. Samples for a detailed geochemical study and isotopic age-dating from representative units across the transect are being analyzed.

The project location is shown in figure 22.

**Project Title:** Geology and Mineral Resources of the Petersburg 1:250,000-scale Quadrangle and Some Contiguous Areas (AMRAP and Geologic Framework and Synthesis Program)

**Chief:** David A. Brew

**Objectives:** To carry out reconnaissance geologic and geochemical mapping and mineral-resource assessment of the project area where diverse structural, stratigraphic, and tectonic units come together. The project will include geophysical

surveys and will draw upon previous geologic studies to the west and northwest by L. J. P. Muffler, to the northwest by R. A. Loney, to the south and west by A. T. Ovenshine, to the south by G. D. Eberlein and Michael Churkin, Jr., to the southeast by H. C. Berg and D. L. Jones, and to the north and east by D. A. Brew, A. L. Clark, and D. G. Grybeck.

**Status:** The 1981 field season was the fourth for this project. Geologic mapping of the southern, western, and northeastern parts of the project area, comprising Etolin, Zarembo, northern Prince of Wales, Kuiu Islands, and parts of the mainland, is now largely complete. In addition, parts of Kupreanof Island and other parts of the mainland have also been mapped. Stream-sediment sampling has been completed by the related geochemistry project (J. B. Cathrall, Chief). Compilation of data from previous mapping in the area is under way, as are a major-element study of the granitic rocks and other topical studies. The results of aeromagnetic surveys and a review of known mineral deposits, as well as occurrences discovered during current fieldwork, and pertinent geochemical data have been placed on open file. An aeroradiometric survey of areas geologically favorable for uranium has been flown, and the results are being compiled. Bedrock geochemical data are being prepared for statistical analysis on a map-unit by map-unit basis.

The projected location is shown in figure 22.

**Project Title:** Mineral Resources of Petersburg (1:250,000-scale) Quadrangle (AMRAP)

**Chief:** John B. Cathrall

**Objectives:** The major objectives are: To appraise the mineral-resource potential and to complete reconnaissance geochemical mapping of the Petersburg (1:250,000-scale) quadrangle where diverse stratigraphic and tectonic units or terranes come together. The secondary objectives include geostatistical-geochemical studies for single elements, ratios of elements, and vector enrichments using the results of analysis of stream sediments, heavy-mineral panned concentrates from stream sediments, and rock units. To accomplish these objectives, drainage systems, rock units, fault zones, altered and (or) mineralized zones, and favorable host rock will be sampled and the geochemical results integrated with the results of studies of the geologic and geophysical environments of the area; maps will be prepared and interpreted; and the integrated conclusions will be prepared for publication as a series of maps and short reports.

**Status:** To date, about 1,600 panned-concentrate samples, 1,600 stream-sediment samples, and 800 stream pebble samples have been collected. Areas identified as anomalous on the basis of 1978-80 results were revisited in 1981. Approximately 600 stream-sediment samples have been analyzed for uranium and thorium. It is possible to identify a belt of rocks located in the Etolin-Kuiu Island complex in which uranium is enriched relative to thorium. A pattern of copper-zinc-lead zoning is

becoming defineable in the Duncan Canal-Zarembo Island area, Saginaw and Kadak Bay area, southwestern Kupreanof Island area, and Stevenson Island area.

The project location is shown in figure 22.

Project Title: Sitka Observatory

Chief: Willis E. Osbakken

Objectives: To operate seismic instruments for acquiring information on the global occurrence of earthquakes; to transmit seismic and tidal data to the Alaska Tsunami Warning Center at Palmer; and to record and measure, on a continuous basis, the various elements of the Earth's magnetic field and distribute these data either directly or through the Branch of Electromagnetism and Geomagnetism to domestic and foreign data users.

Status: With continuous magnetograph recordings since 1902, the Sitka Observatory is among the oldest recording magnetic observatories in existence, which makes it one of the more valuable magnetic observatories in the world. The data recorded at Sitka constitute important input to the base data file used to compile magnetic and navigation charts. The data from Sitka and other observatories are used internationally to support magnetic research studies in solid earth, upper atmospheric, and space research. Sitka is one of the 13 stations used in the derivation of  $K_p$ , the planetary geomagnetic activity index. The observatory has functioned as a seismograph station since 1904. Besides telemetering seismic data to Palmer, the station furnishes seismic recordings to the National Earthquake Information Service for epicenter studies. The observatory also operates a tide station for the National Oceanographic and Atmospheric Administration Pacific Tide Party and is a cooperative observer for the National Weather Service.

The observatory location is shown in figure 22.

## OFFSHORE

Project Title: Arctic Marine Sedimentary Processes (Marine Geology Program)

Chiefs: Peter W. Barnes, Erk Reimnitz, Ralph E. Hunter, and R. Larry Phillips

Objectives: To define the sedimentary processes of the continental shelf off northern Alaska. Studies will concentrate on: (1) defining the source, mode of emplacement, and physical and chemical composition of seabed materials; (2) studying the present sediment-transport regime (including ice rafting, currents, ice grounding, barrier islands, and shoals); and (3) examining the historical record to provide information concerning the stability of the present regime and its behavior in the past. In all studies, processes involving sea ice will be emphasized.

Status: The character of the seabed and the character and source of seabed materials are

reasonably well known for the Beaufort Sea from earlier work on this project. The studies in the Beaufort Sea are now focusing on interrelated processes and rates of processes. The topic of sea ice as a geologic agent has been little studied, and unraveling the relationships between ice and geologic processes is a continuing effort and a source of questions and challenges. For instance, a submarine bench or shoal commonly marks the boundary between the smooth inshore ice and the stamukhi (zone of grounded ice ridges) and appears to be related to the ice zonation; however, the relationships between this bench and the associated ridges are not understood. When storms occur during ice formation in the fall, vast quantities of fine-grained sediment are entrained in the ice, yet the mechanisms of sediment entrainment and significance to the sediment-transport regime remain to be studied.

Work has started on characterizing the nearshore seabed environment of the Chukchi Sea. Ice effects are important here, as in the Beaufort Sea, but the effects of currents and waves are also important, more so than in the Beaufort Sea. The major capes are sites of especially intense sediment transport by currents.

The location of the project is shown in figure 23.

Project Title: Geologic Framework and Resource Assessment, Beaufort and Chukchi Seas (Marine Geology Program)

Chief: Arthur Grantz

Objectives: To determine the geologic framework and petroleum potential of the continental shelf and slope in the Beaufort and Chukchi Seas.

Status: The reconnaissance phase of the project, which depended heavily on single-channel seismic data, has generally defined the major geologic provinces and gross structure of the Beaufort-Chukchi shelf and continental slope. The project is now acquiring, processing, and interpreting multi-channel seismic-reflection data for a more detailed determination of the geologic framework and petroleum potential of the region. Gravity anomaly and seismic-refraction (sonobuoy) data have also been gathered. All planned data releases and reports covering the reconnaissance phase of the project have been published, and the first of a series of reports and maps based on the multi-channel data is in press. A number of ancillary maps and reports showing the bathymetry and selected Quaternary geologic features of environmental concern have also been released.

The project location is shown in figure 23.

Project Title: Geology and Resource Assessment of the Northern Bering Sea (Marine Geology Program)

Chief: Michael A. Fisher

Objectives: To study the geologic history and structure and the petroleum geology of the northern Bering Sea, including Norton Basin.

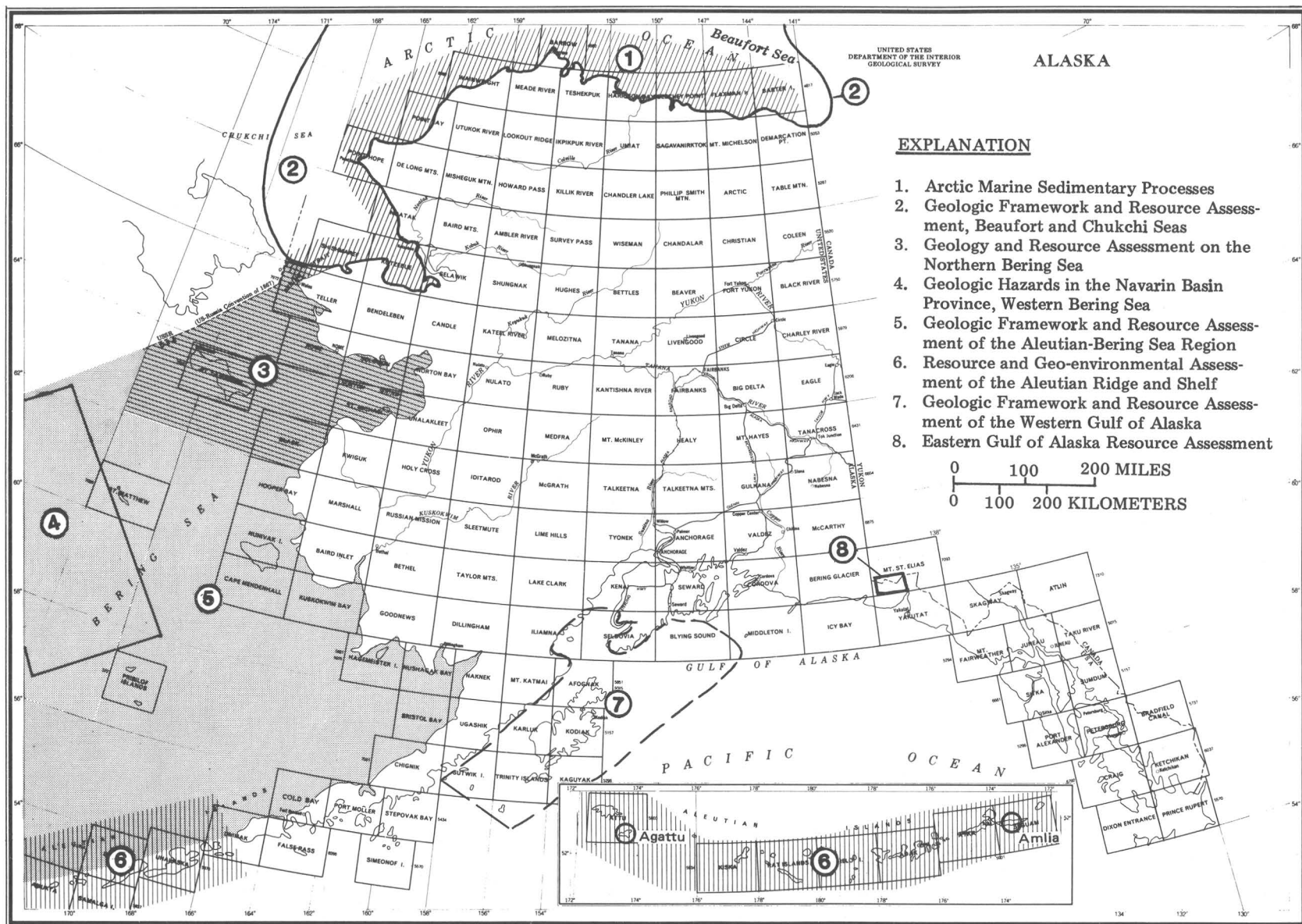


Figure 23.—Offshore geologic activities in Alaska, Marine Geology Program.

## GEOLOGIC

Status: Gravity data collected in 1978 and 1980 are being published in final map form, and 24-channel seismic data collected in 1978 have been interpreted. The resulting map of basin structure is being modified on the basis of information collected during a cruise in 1980. Also during that year, data were collected from 35 sonobuoys. No fieldwork was done in 1981, but seismic-reflection and gravity data were processed. Modelling of gravity data has begun, using basin structures derived from the seismic data. In FY 1982 this project may coordinate its activities with those of a consortium of industrial associates. COST well data will be made available to the public late in 1982.

The project location is shown in figure 23.

Project Title: Geologic Hazards in Navarin Basin Province, Western Bering Sea (Marine Geology Program)

Chiefs: Paul R. Carlson and Herman A. Karl

Objectives: To determine the type, areal extent, age, degree of activity, and potential problems of seafloor geologic hazards in the Navarin Basin province. Types of hazards being studied include faults, submarine slides, gas-charged sediments, and active bedforms.

Status: The 1981 6-week cruise on the National Oceanic and Atmospheric Administration ship *Discoverer* completed a reconnaissance-level regional grid of the Navarin Basin province, where an Outer Continental Shelf lease is planned for early 1984. Data being processed for analyses include 3.5 kiloHertz, minisparker, and airgun reflection profiles, suspended-sediment samples, and gravity cores. No cruise is scheduled for 1982. A report on large sand waves on the floor of the Navarin Basin is in review, and other reports are in preparation.

The project location is shown in figure 23.

Project Title: Geologic Framework and Resource Assessment of the Aleutian-Bering Sea Region (Marine Geology Program)

Chief: Michael S. Marlow

Objectives: To evaluate the resource potential, including possible oil and gas deposits, of the Bering Sea region, and to ascertain the regional tectonic and geologic framework of the Bering Sea in relation to Alaska, Siberia, and the North Pacific.

Status: Since 1975, approximately 6,200 miles of 24-channel seismic-reflection data has been collected over the eastern Bering Sea shelf and the adjacent abyssal Aleutian Basin. Copies of the records are available from the National Oceanic and Atmospheric Administration. Preliminary descriptions and ages for dredge samples collected in 1978 have been published as Open-File Report 81-1297. During 1980, we collected about 1,700 miles of multichannel seismic-reflection data in the north end of the

Navarin Basin, but no fieldwork was done in 1981. Data from the 1980 cruise are in reports that are now in review. Resource reports for the Bureau of Land Management and the Department of State on Bristol Bay and the Navarin Basin have been published as Open-File Reports 80-653 and 81-0252, respectively. In FY 1982 project personnel plan to coordinate geophysical surveying from two ships working in all major basins and in some deep water areas in the study region with a consortium of industrial associates. In addition, two COST wells are being planned; data resulting from work on these wells will, however, be proprietary until a lease sale in the area is scheduled.

The project area is shown in figure 23.

Project Title: Resource and Geo-environmental Assessment of the Aleutian Ridge and Shelf (Marine Geology Program)

Chiefs: David W. Scholl and Tracy L. Vallier

Objectives: To gather and interpret geophysical and geologic data and to study seafloor processes. These investigations are needed to assess the regional petroleum and mineral resources and geohazards of the frontier areas of the Aleutian Ridge and Shelf. Marine geophysical data (including reflection- and refraction-seismic data), as well as gravity and magnetics data, are used in conjunction with geologic information obtained by investigating the insular geology, submerged bedrock outcrops, sediment samples, and cores from test wells in order to prepare resource and hazard assessments. The same data base is used to determine the tectonic and geologic histories of the Aleutian Ridge, which is a complex magmatic arc that in many places includes thick masses of Cenozoic sedimentary deposits.

Status: During the project's first two years, data collection was done during short field seasons. In 1979, single-channel seismic-reflection profiles and dredge hauls were collected from the R/V *Sea Sounder* in the Amlia area of the Aleutian Ridge. Geologic reconnaissance mapping and rock sampling were completed on Amlia and Atka Islands. In 1980, about 450 miles of multichannel seismic profiles was collected over the Aleutian Ridge in the Amlia corridor. These seismic profiles are now partly processed and analyzed. In 1981 the first phase of multichannel reflection profiling in the Amlia corridor was completed by the collection of about 1,000 miles of new data, and reconnaissance work was begun in the Agattu corridor. Initial processing of the seismic data and analyses of offshore dredge samples from Amatignak, Agattu, and Koniugi Islands have begun. A report on the initial implications of data from the Amlia area of the Aleutian Ridge will appear in a memoir of the American Association of Petroleum Geologists.

The project location is shown in figure 23.

Project Title: Geologic Framework and Resource Assessment of the Western Gulf of Alaska (Marine Geology Program)



Chief: Roland von Huene

Objectives: To map the Neogene tectonic framework of the Outer Continental Shelf between Middleton and Chirikof Islands. An understanding of the geologic history will be developed to predict where geologic events have been conducive to the formation of hydrocarbon resources. The neotectonics associated with the 1964 and earlier earthquakes will be documented and modelled. A regional synthesis will be the end product.

In the lower Cook Inlet-Shelikof Strait area, new reflection-seismic data will be correlated with lithologic and biostratigraphic data from the COST well to allow mapping of major units of Mesozoic and Cenozoic rocks. Gravity and magnetic data will be modelled in conjunction with reflection-seismic data to infer the characteristics of basement rocks.

Status: Approximately two-thirds of the geophysical fieldwork and one-third of the sampling have been accomplished. Preliminary reports and maps have been prepared showing the first half of these data, and the results of studies of the data have appeared in open-file reports and scientific journals. A cruise to accomplish about half the

remaining work is being planned for the summer of 1982.

The project location is shown in figure 23.

Project Title: Eastern Gulf of Alaska Resource Assessment (Marine Geology Program)

Chief: George Plafker

Objectives: To evaluate the tectonic framework, petroleum potential, and geologic hazards of the eastern Gulf of Alaska Outer Continental Shelf and contiguous areas.

Status: Acquisition of marine geophysical data is complete. Maps and reports on the structure, magnetics, stratigraphy, gravity, and bathymetry of the region are in various stages of preparation or have been published. During 1982 a detailed field study is planned for the Samovar Hills area of the Mount Saint Elias quadrangle to compare the petroliferous Paleogene sequence in outcrop with coeval rocks dredged from the Yakutat continental slope.

The project location is shown in figure 23.



Gould Hall on the Alaska Pacific University campus in Anchorage is the new headquarters for the Branch of Alaskan Geology in Alaska. The scientists and support staff moved into the building in late 1981.



## Public Inquiries Office, Supporting Division and Services



Alaska Distribution Section office, Fairbanks.

### PUBLIC INQUIRIES OFFICE

The Public Inquiries Office (PIO) in Anchorage serves as a contact for obtaining information about the activities and products of the Survey and provides referral services for individuals seeking technical information about the Survey's programs and work. The office keeps a stock of Alaska maps for over-the-counter sales and, as an agent of the Superintendent of Documents, sells Geological Survey books relating to Alaska. (Information about publications is given in the introductory pages of this Circular.) The PIO in Anchorage also contains a microfilm browse file where customers can view Landsat (satellite) photography, which can be ordered from the EROS Data Center, Sioux Falls, S. D.

The PIO is part of the National Mapping Division and is under the direction of the Office of Public Inquiries headquartered at the National Center in Reston, Va. The PIO in Anchorage is supervised by Elizabeth C. Behrendt and is located at Room 108 of the Skyline Building at 508 Second Avenue.

The Alaska Distribution Section in Fairbanks distributes Survey maps, indexes, and leaflets over the counter and by mail to the public and to Federal and State agencies, and it supplies maps to 35 commercial dealers in the State. The Alaska Distribution Section is under the direction of the Distribution Branch in Denver, which, in turn, is part of the National Mapping Division. The Alaska office is supervised by Natalie A. Cornforth and is located in Room 126 of the Federal Building at 101 Twelfth Avenue, Fairbanks, Alaska 99701.

### ADMINISTRATIVE DIVISION

The Alaska Field Office of the Administrative Division provides service and supply support to the Survey offices and personnel in Alaska. The office is supervised by:

Betty J. McIntire  
204 Skyline Building  
218 E Street  
Anchorage, Alaska 99501  
Tel. (907) 271-4145

A warehouse for Survey equipment is located just inside the Elmendorf Air Force Base to the east of Anchorage. The warehouse is under the immediate supervision of:

Harvey Haynes  
5500 Oilwell Road  
Elmendorf Air Force Base  
Anchorage, Alaska 99506  
Tel. (907) 752-3834

A warehouse for the Fairbanks area is located at Fort Wainwright but is not staffed. The telephone number at Fort Wainwright is (907) 353-6111.

A radio network is operated during the field season for communication among the field camps and with Anchorage or Fairbanks. The official Survey frequencies are 5380 (USB 5381.5) and 3211 (USB 3212.5) kilohertz. The Anchorage base station (KWA 351) is located at 218 E Street and monitors 5380 during office hours. Commercial stations WKD 22 in Anchorage and KGA 85 ("Broadmoor") in Fairbanks, both of which monitor 5167.5 (USB

## PIO AND OTHER SERVICES

5168.9), handle non-routine Survey messages. For further information about the Survey's radio operations, contact:

Florence R. Weber  
P.O. Box 80586  
Fairbanks, Alaska 99708  
Tel. (907) 479-7245

The Administrative Division office also handles emergency messages to or from Survey offices or families of employees. During regular hours, the Anchorage office can be contacted; at other times Betty McIntire can be contacted at (907) 272-5398.

## ALASKA CORE LIBRARY

The Core Library preserves and makes available for study the Survey's large collection of Alaskan well cores. Most of these cores are from the National Petroleum Reserve in Alaska (NPR), formerly known as the Naval Petroleum Reserve No. 4 (NPR-4); the nucleus of the library is about 25,000 feet of cores taken during exploration of the Reserve in the 1940's and 1950's. The library also includes some cores and a large amount of ditch cuttings from wells drilled on Federal lands in other parts of Alaska.

The Alaska Core Library is currently housed in three buildings at the corner of Boyd and Manor Streets on Government Hill in Anchorage. The library is managed by the Branch of Alaskan Geology.

The director of the library's activities is:

W. L. Adkison  
2525 C Street, Suite 400  
Anchorage, Alaska 99503  
Tel. (907) 276-7422  
Library: (907) 274-1345

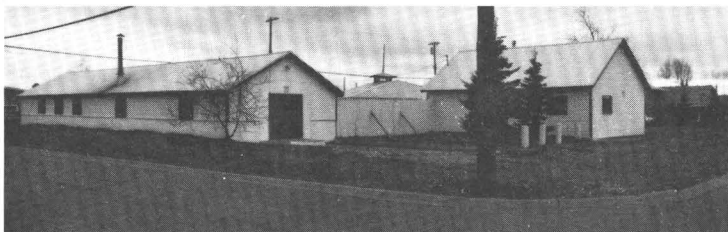
## TECHNICAL DATA UNIT

The Alaska Technical Data Unit (Tech. Data) provides information to Survey personnel and the public on earth science literature about Alaska with emphasis on U.S. Geological Survey, Alaska Division of Geological and Geophysical Surveys, and U.S. Bureau of Mines publications. In addition to serving as depository for Branch of Alaskan Geology project files and related materials, Tech. Data maintains a small reference library, prepares a monthly list of Alaskan publications, and performs various procurement and publication services for Branch of Alaskan Geology personnel. For further information contact:

Ellen R. White  
Technical Data Unit  
Branch of Alaskan Geology  
U.S. Geological Survey  
345 Middlefield Road, MS 48  
Menlo Park, California 94025  
Tel. (415) 323-8111 ext. 2342 or 2684

In preparation for the unit's move to a new headquarters in Anchorage, Tech. Data has recently undertaken compilation of a computerized index. The index will provide rapid identification of and access to published Alaskan earth science literature and various types of unpublished materials in Tech. Data files (currently totalling an estimated 15,600 items and growing at the rate of more than 600 items annually).

To date, development of the data definition and data base schema by Bruce B. Salem has been completed. Indexing of the files has been temporarily suspended.



The Core Library's storage and research facilities.

Table 3. -- Listing of project chiefs, associated personnel, and brief description of project work

Project Chief	Associated Personnel	Organizational Designation	Region of Operation	Type of Work	Mailing Address and Telephone Number
Ager, T. A.	Bradbury, J. P.	Geologic	Southwestern	Quaternary climate and palyrostratigraphical studies	Paleontology and Stratigraphy Branch 970 National Center Reston, VA 22092 (703) 860-7745
Ager, T. A.	Forester, R. M. Bryant, W. A.	Geologic	Southern	Climate and tephrochronology studies	Paleontology and Stratigraphy Branch 970 National Center Reston, VA 22092 (703) 860-7745
Barnes, D. F.	Morin, R. L. Burns, L. E.	Geologic	Statewide	Gravity studies and standardization of gravity surveys	Branch of Regional Geophysics 345 Middlefield Road, MS 18 Menlo Park, CA 94025 (415) 323-8111 x 2457
Barnes, P. W., Reimnitz, Erk, Hunter, R. E. and Phillips, R. L.	Kempema, E. W. Minkler, P. W. Rearic, D. M. Reiss, T. E.	Geologic	Offshore	Studies of Arctic marine sedimentary processes and hazards, Beaufort and Chukchi Seas	Branch of Pacific-Arctic Geology 345 Middlefield Road, MS 99 Menlo Park, CA 94025 (415) 856-7008 (Barnes)
Bartsch-Winkler, Susan	--	Geologic	Southern	Determining sediment transport and deposition in the coastal region near Anchorage	Branch of Alaskan Geology Gould Hall, APU Campus University Drive Anchorage, AK 99501 (907) 278-3571
Bender, Lee	--	National Mapping	Southwestern	Development of radar image maps of Ugashik	Eastern Mapping Center 522 National Center Reston, VA 22092 (703) 860-6273
Berg, H. C.	Decker, J. E. (State of AK) Coney, P. J. (Univ. of AZ) Saleeby, Jason (Cal. Tech.)	Geologic	Southeastern	Studies of geotectonics, metallogenesis, and resource appraisal	Branch of Alaskan Geology 345 Middlefield Road, MS 17 Menlo Park, CA 94025 (415) 323-8111 x 2234
Bird, K. J.	--	Geologic	Northern	Petroleum resource studies	Branch of Oil & Gas Resources 345 Middlefield Road, MS 99 Menlo Park, CA 94025 (415) 856-8034
Blanchard, D. C.	--	ONPRA	Northern	Maintaining paleontological data files for NPRA	ONPRA Casa Mills 200 Middlefield Road, MS 87 Menlo Park, CA 94025 (415) 323-8111 x 2137

Table 3. -- Listing of project chiefs, associated personnel, and brief description of project work -- Continued

Project Chief	Associated Personnel	Organizational Designation	Region of Operation	Type of Work	Mailing Address and Telephone Number
Bolm, J. G., Larson, J. A., and Turner, R. F.	--	Minerals Management Service	Southern	Integration of well, outcrop and seismic data, lower Cook Inlet	Alaska Regional Office 800 A Street Anchorage, AK 99501 (907) 271-4583
Bolm, J. G., and Lyle, W. M. (State of Alaska)	--	Minerals Management Service	Southern	Integration of onshore and off- shore geologic data, lower Cook Inlet	800 A Street Anchorage, AK 99501 (907) 271-538 (Bolm) Division of Geological and Geophysical Surveys 3001 Porcupine Drive Anchorage, AK 99501 (907) 277-6615 (Lyle)
Brabets, T. P.	Emanuel, R. P. Lee, M. G. Wittenberg, L. A.	Water Resources	Southern	Geohydrologic studies, Municipality of Anchorage	Anchorage Subdistrict Office 1209 Orca Street Anchorage, AK 99501 (907) 271-4153
Brabets, T. P.	Wittenberg, L. A. Lee, M. G.	Water Resources	Southern	Water-quality characteristics of surface-water runoff in Chester Creek, Anchorage	Anchorage Subdistrict Office 1209 Orca Street Anchorage, AK 99501 (907) 271-4153
Brew, D. A.	--	Geologic	Southeastern	Glacier Bay National Monument Wilderness study area mapping and mineral-resource appraisal	Branch of Alaskan Geology 345 Middlefield Road, MS 90-B Menlo Park, CA 94025 (415) 323-8111 x 4127
Brew, D. A.	Berg, H. C. Barnes, D. F. Barrell, P. D. Ford, A. B. Grybeck, Donald Himmelberg, G. R. Hunt, S. J. Karl, S. M. Koch, R. D. Lanphere, M. A. Loney, R. A.; Sonnevil, R. A. (Nat. Park Service)	Geologic	Southeastern	Mineral-resource appraisal near Juneau (AMRAP)	Branch of Alaskan Geology 345 Middlefield Road, MS 90-B Menlo Park, CA 94025 (415) 323-8111 x 4127
Brew, D. A.	Ford, A. B. Karl, S. M.	Geologic	Southeastern	Mapping and mineral-resource appraisal in Petersburg quad- rangles and some contiguous areas (AMRAP)	Branch of Alaskan Geology 345 Middlefield Road, MS 90-B Menlo Park, CA 94025 (415) 323-8111 x 4127

Table 3. -- Listing of project chiefs, associated personnel, and brief description of project work -- Continued

Project Chief	Associated Personnel	Organizational Designation	Region of Operation	Type of Work	Mailing Address and Telephone Number
Brosge', W. P.	Dutro, J. T., Jr. Moore, T. E.	Geologic	East-central	Mineral-resource assessment of Wiseman quadrangle	Branch of Alaskan Geology 345 Middlefield Road, MS 90-B Menlo Park, CA 94025 (415) 323-8111 x 4121
Brosge', W. P.	Nilsen, T. H. Dutro, J. T., Jr. Moore, T. E.	Geologic	Northern, East-central	Direction of sediment transport, facies trends, Devonian clastic rocks, Brooks Range	Branch of Alaskan Geology 345 Middlefield Road, MS 90-B Menlo Park, CA 94025 (415) 323-8111 x 4121
Brosge', W. P.	Reiser, H. N. Dutro, J. T., Jr. Detterman, R. L.	Geologic	Northern	Geologic mapping, southeast Brooks Range	Branch of Alaskan Geology 345 Middlefield Road, MS 90-B Menlo Park, CA 94025 (415) 323-8111 x 4121
Bugliosi, E. F.	--	Water Resources	Southeastern	Water resources of the Chilkat River basin near Haines	Juneau Subdistrict Office P.O. Box 1568 Juneau, AK 99802 (907) 586-7216
Burrows, R. L.	Emmett, W. W. Wilcox, D. E.	Water Resources	East-central	Sediment transport in the Tanana River near Fairbanks	Fairbanks Subdistrict Office 101 12th Avenue, Box 11 Fairbanks, AK 99701 (907) 456-0214
Callahan, J. E.	--	Minerals Management Service	Northern	Determination of coal resources, NPRA	Alaska Regional Office 411 W. 4th Avenue Anchorage, AK 99501 (907) 271-4581
Carlson, P. R., and Karl, H. A.	Fisher, J. M.	Geologic	Offshore	Studies of geologic hazards, Navarin Basin	Branch of Pacific-Arctic Geology 345 Middlefield Road, MS 99 Menlo Park, CA 94025 (415) 856-7021 (Carlson) -7053 (Karl)
Carnegie, D. M.	Staff members	EROS Field Office	Statewide	Remote-sensing training program	EROS Field Office 218 E Street Anchorage, AK 99501 (907) 271-4065
Carnegie, D. M., and Fleming, M. D.	Krebs, P. V. (BLM) Spencer, Page (BLM) LaBau, V. J. (USFS) Wibbenmeyer, M. (ADNR) Grunblatt, J. (ADNR) Winterberger, K. (USFS)	EROS Field Office	Statewide	Operation of IDIMS for vegetation classification	EROS Field Office 218 E Street Anchorage, AK 99501 (907) 271-4065
Carnegie, D. M., Shasby, M. B., and Fleming, M. D.	Talbot, Steven (USFWS)	EROS Field Office	Southwestern	Land-cover and terrain mapping, Togiak National Wildlife Refuge	EROS Field Office 218 E Street Anchorage, AK 99501 (907) 271-4065

Table 3. -- Listing of project chiefs, associated personnel, and brief description of project work -- Continued

Project Chief	Associated Personnel	Organizational Designation	Region of Operation	Type of Work	Mailing Address and Telephone Number
Carter, L. D.	Galloway, J. P.	Geologic	East-central	Mapping surficial geology in Tanana Valley corridor	Branch of Alaskan Geology Gould Hall, APU Campus University Drive Anchorage, AK 99504 (907) 278-3571
Carter, L. D.	Galloway, J. P.	Geologic	Northern	Studies of Quaternary history, western Arctic Coastal Plain	Branch of Alaskan Geology Gould Hall, APU Campus University Drive Anchorage, AK 99504 (907) 278-3571
Cathrall, J. B.	Day, G. W. Hoffman, J. D.	Geologic	Southeastern	Mineral-resource appraisal and geochemical mapping of the Petersburg quadrangle	Branch of Exploration Research Denver Federal Center, Box 25046 Lakewood, CO 80225 (303) 234-4813
Cathrall, J. B.	Hoffman, J. D. Day, G. W. O'Leary, R. M.	Geologic	East-central	Mineral-resource appraisal and geochemical mapping of the Wiseman quadrangle	Branch of Exploration Research Denver Federal Center, Box 25046 Lakewood, CO 80225 (303) 234-4813
Chapman, R. M.	Patton, W. W., Jr. Moll, E. J.	Geologic	West-central	Mineral-resource evaluation and mapping, Ophir, Kantishna River, and Tanana quadrangles	Branch of Alaskan Geology 345 Middlefield Road, MS 90-B Menlo Park, CA 94025 (415) 323-8111 x 4131
Church, S. E.	--	Geologic	Northern	Geochemical studies, Killik River and Chandler Lake quadrangles (AMRAP)	Branch of Exploration Research Box 25046, Federal Center, MS 955 Lakewood, CO 80225 (303) 234-3665
Cobb, E. H.	--	Geologic	Statewide	Compilation of data on mineral resources	Branch of Alaskan Geology 345 Middlefield Road, MS 48 Menlo Park, CA 94025 (415) 323-8111 x 2483
Comer, C. D.	--	Minerals Management Service	Southwestern	Mapping shallow geologic features, southern Bering Sea	Alaska Regional Office 800 A Street Anchorage, AK 99501 (907) 271-4549
Craig, J. D.	(See Thrasher, G. P.)				
Csejtey, Béla, Jr.	Cox, D. P. Stricker, G. D.	Geologic	Southern	Mineral-resource appraisal, Healy quadrangle (AMRAP)	Branch of Alaskan Geology 345 Middlefield Road, MS 17 Menlo Park, CA 94025 (415) 323-8111 x 2613



Table 3. -- Listing of project chiefs, associated personnel, and brief description of project work -- Continued

Project Chief	Associated Personnel	Organizational Designation	Region of Operation	Type of Work	Mailing Address and Telephone Number
Detterman, R. L.	Miller, T. P. Yount, M. E. Wilson, F. H. Case, J. E. Allaway, W. H. Cox, D. P. Detra, D. E. Shew, Nora Miller, J. W.	Geologic	Southwestern	Mineral-resource appraisal, Ugashik-Karluk quadrangles	Branch of Alaskan Geology 345 Middlefield Road, MS 90-B Menlo Park, CA 94025 (415) 323-8111 x 4132
Dickinson, K. A.	Campbell, J. A. (Ft. Lewis College)	Geologic	Statewide	Evaluation of uranium potential in selected sedimentary basins in Alaska	Branch of Uranium and Thorium Resources Denver Federal Center, Box 25046 Lakewood, CO 80225 (303) 234-5667
Donovan, T. L.	Forgey, R. L. Hendricks, J. D. Roberts, A. A. Spence, B. A. Thompson, C. R.	Geologic	Northern	Study of hydrocarbon seepage relative to magnetite formation, North Slope area	Branch of Oil and Gas Resources 2555 North Gemini Drive Flagstaff, AZ 86001 (502) 779-3311 x 1350
Dover, J. H.	--	Geologic	East-central, West-central	Studies of stratigraphy, structure, and metamorphic history of terranes in central Alaska	Branch of Alaskan Geology Gould Hall, APU Campus University Drive Anchorage, AK 99501 (907) 278-3571
Dusel-Bacon, Cynthia	--	Geologic	Statewide	Compilation of metamorphic facies map	Branch of Alaskan Geology 345 Middlefield Road, MS 90-B Menlo Park, CA 94025 (415) 323-8111 x 4115
Dusel-Bacon, Cynthia	Aleinikoff, J. N. Reading, K. E.	Geologic	East-central	Petrographic studies, Yukon-Tanana Upland	Branch of Alaskan Geology 345 Middlefield Road, MS 90-B Menlo Park, CA 94025 (415) 323-8111 x 4115
Dutro, J. T., Jr.	Mamay, S. H. Sohn, I. G. Palmer, A. R. (GSA, Boulder); Repatski, J.	Geologic	Statewide	Studies of Paleozoic fossils and stratigraphy	U.S. National Museum of Natural History Room E 316 Washington, D. C. 20560 (202) 343-3222
Eberlein, G. D.	(See Lanphere, M. A.)				
Emanuel, R. P.	--	Water Resources	Southern	Evaluation of hydrologic hazards from volcanic activity at Mt. Spurr	Anchorage Subdistrict Office 1209 Orca Street Anchorage, AK 99501 (907) 271-4153

Table 3. -- Listing of project chiefs, associated personnel, and brief description of project work -- Continued

Project Chief	Associated Personnel	Organizational Designation	Region of Operation	Type of Work	Mailing Address and Telephone Number
Emery, P. A.	Jones, S. H.	Water Resources	Southern	Study of water resources, Copper River basin	Alaska District Office 733 W. 4th Avenue, Suite 400 Anchorage, AK 99501 (907) 271-4138
Ferrians, O. J., Jr.	--	Geologic	Northern	Engineering geology investigations, eastern Arctic Coastal Plain	Branch of Alaskan Geology 345 Middlefield Road, MS 90-B Menlo Park, CA 94025 (415) 323-8111 x 4108
Ferrians, O. J., Jr.	--	Geologic	Northern	Northern Alaska engineering geology	Branch of Alaskan Geology 345 Middlefield Road, MS 90-B Menlo Park, CA 94025 (415) 323-8111 x 4108
Ferrians, O. J., Jr.	Schmoll, H. R. Updike, R. G. (State of AK)	Geologic	Southern	Investigation of geologic hazards, Anchorage-Susitna lowlands	Branch of Alaskan Geology 345 Middlefield Road, MS 90-B Menlo Park, CA 94025 (415) 323-8111 x 4108
Fisher, M. A.	Holmes, M. L. Patton, W. W., Jr. McClellan, P. H.	Geologic	Offshore	Assessment of resources and study of geologic history, northern Bering Sea, including Norton Basin	Branch of Pacific-Arctic Geology 345 Middlefield Road, MS 99 Menlo Park, CA 94025 (415) 856-7108
Fleming, M. D.	(See Carnegie, D. M.)				
Fleming, M. D.	(See Shasby, M. B.)				
Fordham, R. E.	--	National Mapping	Statewide	ANILCA boundary map series	Eastern Mapping Center 567 National Center Reston, VA 22092 (703) 860-6352
Fordham, R. E.	(See McLaurin, J. D.)				
Fordham, R. E.	McLaurin, J. D.	National Mapping	Northern	Orthophoto map production	Eastern Mapping Center 567 National Center Reston, VA 22092 (703) 860-6352
Fordham, R. E., McLaurin, J. D.	--	National Mapping	Northern	Coal resources	Eastern Mapping Center 567 National Center Reston, VA 22092 (703) 860-6352

Table 3. -- Listing of project chiefs, associated personnel, and brief description of project work -- Continued

Project Chief	Associated Personnel	Organizational Designation	Region of Operation	Type of Work	Mailing Address and Telephone Number
Foster, H. L.	Weber, F. R. Laird, Jo Cushing, G. W. Menzie, W. D. Crim, W. D. Cady, J. W. Kieth, T. E. C. Wilson, F. H. Aleinikoff, J. N. Tripp, R. B. Dusel-Bacon, C. Yeend, W. E.	Geologic	East-central	Geologic mapping and studies in Yukon-Tanana Upland	Branch of Alaskan Geology 345 Middlefield Road, MS 90-B Menlo Park, CA 94025 (415) 323-8111 x 4106
Gaydos, Leonard	Acevedo, W. (Technicolor Graphic Svcs.) Benjamin, Susan Walker, D. A. (Univ. of CO) Spencer, Page, (BLM)	National Mapping	Northern	Production of land cover maps from Landsat data	Geographic Investigations Office Ames Research Center 240-8 Moffett Field, CA 94035 (415) 965-6368
Gough, L. P. and Severson, R. C.	--	Geologic	Southern	Establishing principles for predicting element concentrations in plants in the Capps coal field	Branch of Regional Geochemistry Box 25045, MS 925 Denver Federal Center Denver, CO 80225 (303) 234-5241
Gough, L. P.	--	Geologic	Statewide	Geochemical census of Alaska	Branch of Regional Geochemistry Box 25046, MS 925 Denver Federal Center Lakewood, CO 80225 (303) 234-5241
Grantz, Arthur	May, S. D. Dinter, D. A.	Geologic	Offshore	Resource appraisal and study of geologic framework, Beaufort-Chukchi Seas	Branch of Alaskan Geology 345 Middlefield Road, MS 17 Menlo Park, CA 94025 (415) 323-8111 x 2259
Grantz, Arthur	Wolfe, J. A.	Geologic	Southern	Stratigraphic and structural studies of the Nelchina area	Branch of Alaskan Geology 345 Middlefield Road, MS 17 Menlo Park, CA 94025 (415) 323-8111 x 2259
Gryc, George	--	ONPRA	Northern	Maintaining open-file data for NPRA	ONPRA Casa Mills 200 Middlefield Road, MS 87 Menlo Park, CA 94025 (415) 323-8111 x 2917

Table 3. -- Listing of project chiefs, associated personnel, and brief description of project work -- Continued

Project Chief	Associated Personnel	Organizational Designation	Region of Operation	Type of Work	Mailing Address and Telephone Number
Hamilton, T. D.	Obi, Curtis van Etten, D. P.	Geologic	Northern	Studies of surficial geology, Brooks Range	Branch of Alaskan Geology Gould Hall, APU Campus University Drive Anchorage, AK 99504 (907) 278-3571
Hoffman, J. D.	Sutley, S. J. Day, G. W.	Geologic	Southern	Geochemical work in support of AMRAP and RARE II studies	Branch of Exploration Research 5946 McIntyre Street Golden, CO 80401 (303) 234-3552
Hoose, P. J.	--	Minerals Management Service	Southwestern	Mapping shallow geologic features, northern Aleutian Shelf	Alaska Regional Office 800 A Street Anchorage, AK 99501 (907) 271-4573
Hunter, R. E.	(See Barnes, P. W.)				
Jones, D. L.	Silberling, N. J. Hillhouse, J. H. Coney, P. (Univ. of AZ)	Geologic	Statewide	Compilation of tectonostratigraphic map of Alaska	Branch of Paleontology and Stratigraphy 345 Middlefield Road, MS 99 Menlo Park, CA 94025 (415) 323-8111 x 2269
Kachadoorian, Reuben	--	Geologic	Northern	Engineering geology studies in NPRA	Branch of Alaskan Geology 345 Middlefield Road, MS 90-B Menlo Park, CA 94025 (415) 323-8111 x 4129
Karl, H. A.	(See Carlson, P. R.)				
Kelley, John	--	Geologic	Northern	Resource mapping, Killik River and Chandler Lake quadrangles	Branch of Alaskan Geology 345 Middlefield Road, MS 90-B Menlo Park, CA 94025 (415) 323-8111 x 4116
Kharaka, Y. K.	Carothers, W. W.	Water Resources	Northern	Geochemical studies of oilfield waters, NPRA	Office of Regional Research Hydrologist 345 Middlefield Road, MS 27 Menlo Park, CA 94025 (415) 323-8111 x 2144
King, H. D.	--	Geologic	Southern	Geochemical mapping, Healy quadrangle (AMRAP)	Branch of Exploration Research 5946 McIntyre Street Golden, CO 80401 (303) 234-6186
King, H. D.	--	Geologic	West-central	Geochemical mapping, Solomon and Bendeleben quadrangles (AMRAP)	Branch of Exploration Research 5946 McIntyre Street Golden, CO 80401 (303) 234-6186

Table 3. -- Listing of project chiefs, associated personnel, and brief description of project work -- Continued

Project Chief	Associated Personnel	Organizational Designation	Region of Operation	Type of Work	Mailing Address and Telephone Number
Kirschner, C. E.	--	Geologic	Northern	Study of stratigraphy and structure, NPRA	Branch of Oil and Gas Resources 345 Middlefield Road, MS 87 Menlo Park, CA 94025 (415) 323-8111 x 2135
Knott, J. M.	Lamke, R. D. Madison, R. J. Brunett, J. O.	Water Resources	Statewide	Collection of stream-sediment data	Alaska District Office 733 W. 4th Avenue, Suite 400 Anchorage, AK 99501 (907) 271-4138
Knott, J. M.	Lipscomb, S. W.	Water Resources	Southern	Study of sediment transport by the Susitna River below Devils Canyon	Anchorage Subdistrict Office 1209 Orca Street Anchorage, AK 99501 (907) 271-4153
Lachenbruch, A. H.	--	Geologic	Statewide	Heat-flow studies	Branch of Tectonophysics 345 Middlefield Road, MS 18 Menlo Park, CA 94025 (415) 323-8111 x 2272
Lahr, J. C.	Page, R. A. Stephens, C. D. Rogers, J. A. Fogleman, K. A. Tam, Roy Melnick, J. P. Freiberg, J. A. Brown, P. G. Romes, B.	Geologic	Southern	Studies of current tectonic processes generating earthquakes in Alaska to evaluate hazards and document changes premonitory to large earthquakes	Branch of Ground Motion and Faulting 345 Middlefield Road, MS 77 Menlo Park, CA 94025 (415) 323-8111 x 2510
Lamke, R. D.	--	Water Resources	Statewide	Collection of surface-water data	Alaska District Office 733 W. 4th Avenue, Suite 400 Anchorage, AK 99501 (907) 271-4138
Lanphere, M. A., and Eberlein, G. D.	--	Geologic	Statewide	Compiling map of Precambrian rocks of Alaska and formulation of a time scale as part of an international study	Office of Geochemistry and Geophysics Branch of Isotope Geology 345 Middlefield Road, MS 18 Menlo Park, CA 94025 (415) 323-8111 x 2649
Lantz, R. J.	--	ONPRA	Northern	Development, and operation of gas fields near Barrow	District Bldg., Suite 110 "U" 1109 NE 45th Street Seattle, WA 98105 (206) 442-1995

Table 3. -- Listing of project chiefs, associated personnel, and brief description of project work -- Continued

Project Chief	Associated Personnel	Organizational Designation	Region of Operation	Type of Work	Mailing Address and Telephone Number
Larson, J. A.	--	Minerals Management Service	Northern, West-central, Southern, Southwestern	Conodont biostratigraphy and thermal maturity of rocks	Alaska Regional Office 800 A Street Anchorage, AK 99501 (907) 271-4442
Larson, J. A.	--	Minerals Management Service	West-central	Conodont biostratigraphy and thermal maturity, Minchumina basin	Alaska Regional Office 800 A Street Anchorage, AK 99501 (907) 271-4442
Lauer, D. T. (EROS), and Miller, John (Univ. of AK)	--	EROS Field Office	East-central	Effect of timing of data collection on vegetation classification techniques	EROS Field Office 218 E Street Anchorage, AK 99501 (907) 271-4065
Loney, R. A.	--	Geologic	West-central	Studies of mafic-ultramafic igneous complexes of Alaska (AMRAP)	Branch of Alaskan Geology 345 Middlefield Road, MS 90-B Menlo Park, CA 94025 (415) 323-8111 x 4146
Madison, R. J.	--	Water Resources	Statewide	Basic-data collection, quality of water	733 W. 4th Avenue, Suite 400 Anchorage, AK 99501 (907) 271-4138
Madison, R. J., and Parks, Bruce	--	Water Resources	Statewide	Study of techniques of hydrologic assessment for water planning and management	Alaska District Office 733 W. 4th Avenue, Suite 400 Anchorage, AK 99501 (907) 271-4138
Magoon, L. B.	Claypool, G. E.	Geologic	Northern	NPRA oil and gas source rock study	Branch of Oil and Gas Resources 345 Middlefield Road, MS 99 Menlo Park, CA 94025 (415) 856-7028
Magoon, L. B.	Claypool, G. E.	Geologic	Southern	Petroleum resource assessment, Cook Inlet, Shelikof Strait	Branch of Oil and Gas Resources 345 Middlefield Road, MS 99 Menlo Park, CA 94025 (415) 856-7028
Marlow, M. S.	Cooper, A. K. Dadisman, S. V.	Geologic	Offshore	Evaluation of resource potential and studies of tectonic framework, Bering Sea region	Branch of Pacific-Arctic Geology 345 Middlefield Road, MS 99 Menlo Park, CA 94025 (415) 856-7092
Mayo, L. R.	Trabant, D. C. March, R. S.	Water Resources	Southern	Studies of lake formation at Knik Glacier	Arctic Research Group 101 12th Avenue, Box 11 Fairbanks, AK 99701 (907) 456-0214

Table 3. -- Listing of project chiefs, associated personnel, and brief description of project work -- Continued

Project Chief	Associated Personnel	Organizational Designation	Region of Operation	Type of Work	Mailing Address and Telephone Number
Mayo, L. R.	Trabant, D. C. March, R. S.	Water Resources	Statewide	Analysis of long-term climate and glacier data	Arctic Research Group 101 12th Avenue, Box 11 Fairbanks, AK 99701 (907) 456-0214
McLaurin, J. D.	--	National Mapping	Northern, West-central, Southern	Production of maps (23 projects)	Rocky Mountain Mapping Center Building 25, Box 25046 510 Denver Federal Center Lakewood, CO 80225 (303) 234-2351
McLaurin, J. D., and Fordham, R. E.	--	National Mapping	Statewide, Northern	Production of orthophoto maps	Rocky Mountain Mapping Center Building 25, Box 25046 510 Denver Federal Center Lakewood, CO 80225 (303) 234-2351
McLaurin, J. D., Fordham, R. E., and Swinnerton, J. R.	--	National Mapping	Statewide	Pilot program, orthophoto map production	Rocky Mountain Mapping Center Building 25, Box 25046 510 Denver Federal Center Lakewood, CO 80225 (303) 234-2351 (McLaurin) Western Mapping Center 345 Middlefield Road, MS 31 Menlo Park, CA 94025 (415) 323-8111 x 2411 (Swinnerton)
Meier, M. F.	Post, A. S. Hodge, S. M. Rasmussen, L. A. Taylor, P. L. Driedger, C. L. Krimmel, R. M. Brown, C. S. Juul-Fountain, A. G.	Water Resources	Statewide	Studies of snow accumulation, melt and runoff on glaciers, water flow through and under glaciers, glacier surges, and stability of calving glaciers	Project Office - Glaciology 1201 Pacific Avenue, Suite 850 Tacoma, WA 98402 (206) 593-6502
Miller, John	(See Lauer, D. T.)				
Miller, T. P.	Grauch, R. I.	Geologic	Statewide	Reconnaissance study of uraniferous plutonic rocks	Branch of Alaskan Geology Gould Hall, APU Campus University Drive Anchorage, AK 99504 (907) 278-3571
Molenaar, C. M.	Huffman, A. C. Bartsch-Winkler, Susan	Geologic	Northern	Stratigraphic, petrographic, and paleontologic studies of Cretaceous rocks, North Slope	Branch of Oil and Gas Resources Box 25046, MS 940 Denver Federal Center Lakewood, CO 80225 (303) 234-4642

Table 3. -- Listing of project chiefs, associated personnel, and brief description of project work -- Continued

Project Chief	Associated Personnel	Organizational Designation	Region of Operation	Type of Work	Mailing Address and Telephone Number
Mortensen, C. E.	Liechti, R. P. Myren, G. D.	Geologic	Southern	Monitoring crustal deformation associated with strain accumulation prior to earthquakes	Branch of Tectonophysics 345 Middlefield Road, MS 77 Menlo Park, CA 94025 (415) 323-8111 x 2583
Nelson, G. L.	--	Water Resources	Statewide	Maintaining ground-water station network	Alaska District Office 733 W. 4th Avenue, Suite 400 Anchorage, AK 99501 (907) 271-4138
Nelson, G. L.	--	Water Resources	Southern	Baseflow study of the Chuitna coal field	Alaska District Office 733 W. 4th Avenue, Suite 400 Anchorage, AK 99501 (907) 271-4138
Nelson, R. E.	--	Geologic	Northern	Study of pollen, insects, and plant macrofossils in the National Petroleum Reserve in Alaska	Quaternary Research Center University of Washington Seattle, WA 98195 (206) 543-2871
Nelson, S. W.	Dumoulin, J. A. Winkler, G. R. Barnes, D. F. Goldfarb, Richard Miller-Hoare, Martha; Hoekzema, R. B., Kurtak, J., and Flecher, S. (Bureau of Mines)	Geologic	Southern	Mineral-resource appraisal of Chugach (RARE II) area	Branch of Alaskan Geology Gould Hall, APU Campus University Drive Anchorage, AK 99504 (907) 278-3571
Nokleberg, W. J.	Lange, I. M. Zehner, R. E. Aleinikoff, J. N. Tripp, R. B. Curtin, G. C. Schwab, C. E. Campbell, J. Buhrmaster, C. L. O'Leary, R. M.	Geologic	Southern	Mineral-resource appraisal, Mount Hayes quadrangle	Branch of Alaskan Geology 345 Middlefield Road, MS 90-B Menlo Park, CA 94025 (415) 323-8111 x 4139
O'Leary, R. M.	Domenico, J. A. Lewis, J. A. Day, G. W.	Geologic	Statewide	Spectrographic and chemical analyses in support of AMRAP	Branch of Exploration Research 5946 McIntyre Street Golden, CO 80401 (303) 234-6151
Osbakken, W. E.	--	Geologic	Southeastern	Operation of Sitka Observatory	Branch of Electromagnetism and Geomagnetism Sitka Observatory, Box 158 Sitka, AK 99835 (907) 747-3332



Table 3. -- Listing of project chiefs, associated personnel, and brief description of project work -- Continued

Project Chief	Associated Personnel	Organizational Designation	Region of Operation	Type of Work	Mailing Address and Telephone Number
Page, R. A.	--	Geologic	Southern	Earthquake source properties in the Yaktaga seismic gap	Branch of Ground Motion and Faulting 345 Middlefield Road, MS 77 Menlo Park, CA 94025 (415) 323-8111 x 2567
Parks, Bruce	(See Madison, R. J.)				
Patrick, L. D.	--	Water Resources	Statewide	Collection of data on water use	Anchorage Subdistrict Office 1209 Orca Street Anchorage, AK 99501 (907) 271-4153
Patrick, L. D.	--	Water Resources	Southern	Hydrologic studies of the Point MacKenzie-Horseshoe Flats area	Anchorage Subdistrict Office 1209 Orca Street Anchorage, AK 99501 (907) 271-4153
Patton, W. W., Jr.	--	Geologic	West-central	Tectonic history of the Yukon-Koyukuk basin	
Patton, W. W., Jr.	Moll, E. J.	Geologic	West-central	Investigations of geology and resources, Norton Sound - Yukon region	Branch of Alaskan Geology 345 Middlefield Road, MS 90-B Menlo Park, CA 94025 (415) 323-8111 x 4105
Petering, G. W.	(See Smith, T. N.)				
Phillips, R. L.	(See Barnes, P. W.)				
Plafker, George	Bruns, T. R. Winkler, G. R.	Geologic	Offshore	Evaluation of tectonic framework, petroleum potential and geo-hazards, eastern Gulf of Alaska OCS	Branch of Alaskan Geology 345 Middlefield Road, MS 90-B Menlo Park, CA 94025 (415) 323-8111 x 4103
Plafker, George	Fisher, Dorothy Hunt, S. J.	Geologic	Statewide	Evaluation of earthquake hazards; studies of tectonic processes	Branch of Alaskan Geology 345 Middlefield Road, MS 90-B Menlo Park, CA 94025 (415) 323-8111 x 4103
Prescott, W. H.	(See Savage, J. C.)				
Reed, B. L.	Lanphere, M. A.	Geologic	Southern, Southwestern	Studies of chronology, chemistry, and tectonics of the Alaska Aleutian Range batholith	Branch of Alaskan Geology Gould Hall, APU Campus University Drive Anchorage, AK 99501 (907) 278-3571

Table 3. -- Listing of project chiefs, associated personnel, and brief description of project work -- Continued

Project Chief	Associated Personnel	Organizational Designation	Region of Operation	Type of Work	Mailing Address and Telephone Number
Reimnitz, Erk	(See Barnes, P. W.)				
Riehle, J. R.	Smith, R. L.	Geologic	Statewide	Reconnaissance study of geothermal resources, mapping, and petrologic studies of young volcanic rocks	Branch of Alaskan Geology Gould Hall, APU Campus University Drive Anchorage, AK 99504 (907) 278-3571
Riehle, J. R.	Till, A. B. Yount, M. E.	Geologic	Southern	Volcanic hazards studies, Cook Inlet	Branch of Alaskan Geology Gould Hall, APU Campus University Drive Anchorage, AK 99501 (907) 278-3571
Savage, J. C., and Prescott, W. H.	King, N. E. Lisowski, Michael Stevenson, E. Hamilton, G. D. Wendt, K. J. Stiffler, C. A. Sutton, J.	Geologic	Southern	Measurement of crustal strain, Yakataga and Shumagin areas	Branch of Tectonophysics 345 Middlefield Road, MS 77 Menlo Park, CA 94025 (415) 323-8111 x 2701
Schmoll, H. R., and Yehle, L. A.	Chleborad, A. F. Gardner, C. A. Pasch, A. D. Odum, J. K.	Geologic	Southern	Regional engineering geology of Cook Inlet coal lands, Alaska	Branch of Engineering Geology Box 25046, MS 903 Denver Federal Center Lakewood, CO 80225 (303) 234-3290, -2999, -3721
Scholl, D. W., and Vallier, T. L.	Stevenson, A. J.	Geologic	Offshore	Assessment of geologic hazards and resources of the Aleutian Ridge and Shelf	Branch of Pacific-Arctic Geology 345 Middlefield Road, MS 99 Menlo Park, CA 94025 (415) 856-7089 (Scholl) -7048 (Vallier)
Scott, K. M.	--	Water Resources	Northern	Arctic stream processes	Laguna Niguel Field Office 5391 Kenosha Lane Irvine, CA 92715 (415) 323-8111 x 2337
Severson, R. C.	(See Gough, L. P.)				
Shasby, M. B.	(See Carneggie, D. M.)				
Shasby, M. B.	Talbot, Steven (USFWS)	EROS Field Office	Southern	Land-cover - terrain mapping in the Kenai National Wildlife Range	EROS Field Office 218 E Street Anchorage, AK 99501 (907) 271-4065

Table 3. -- Listing of project chiefs, associated personnel, and brief description of project work -- Continued

Project Chief	Associated Personnel	Organizational Designation	Region of Operation	Type of Work	Mailing Address and Telephone Number
Shasby, M. B.	Wibbenmeyer, Merlin Grunblatt, Jess (ADNR)	EROS Field Office	Southwestern	Land-cover and terrain mapping, Bristol Bay region	EROS Field Office 218 E Street Anchorage, AK 99501 (907) 271-4065
Shasby, M. B., and Fleming, M. D.	LaBau, V. J., Winterberger, Ken (USFS)	EROS Field Office	East-central	Vegetation classification using Landsat data for renewable resource evaluation research	EROS Field Office 218 E Street Anchorage, AK 99501 (907) 271-4065
Sloan, C. E.	--	Water Resources	Northern	Collection of hydrologic information, North Slope	Alaska District Office 733 W. 4th Avenue, Suite 400 Anchorage, AK 99501 (907) 271-4138
Smith, T. N., and Petering, G. W.	--	Minerals Management Service	Southwestern	Source-rock potential, Pribilof Islands	Alaska Regional Office 800 A Street Anchorage, AK 99501 (907) 271-4406
Smith, T. N., and Petering, G. W.	Bolm, J. G.	Minerals Management Service	Southwestern	Investigation of geology adjacent to OCS sale areas	Alaska Regional Office 800 A Street Anchorage, AK 99501 (907) 271-4406
Steffy, David, and Hoose, P. J.	Lybeck, L.	Minerals Management Service	West-central	Mapping shallow geologic features, Norton basin	Alaska Regional Office 800 A Street Anchorage, AK 99501 (907) 271-4572
Stricker, G. D.	--	Geologic	Statewide	Evaluation of coal resources and assessment of Btu values and other coal characteristics	Branch of Coal Resources Denver Federal Center, Box 25046 Lakewood, CO 80225 (303) 234-3560
Swinnerton, J. R.	(See McLaurin, J. D.)				
Thrasher, G. P.	(See Turner, B. W.)				
Thrasher, G. P., and Craig, J. D.	--	Minerals Management Service	Northern	Mapping shallow geologic features, Beaufort Shelf	Alaska Regional Office 800 A Street Anchorage, AK 99501 (907) 271-4547
Till, Alison	(See York, J. E.)				

Table 3. -- Listing of project chiefs, associated personnel, and brief description of project work -- Continued

Project Chief	Associated Personnel	Organizational Designation	Region of Operation	Type of Work	Mailing Address and Telephone Number
Till, Alison	King, H. D. Dumoulin, J. A.	Geologic	West-central	Mineral resource appraisal, Solomon and Bendeleben quadrangles (AMRAP)	Branch of Alaskan Geology Gould Hall, APU Campus University Drive Anchorage, AK 99504 (907) 278-3571
Townshend, J. B.	Papp, J. E. Sauter, E. A. Nelson, M. N. Cunningham, Teri	Geologic	East-central (location of observatory)	Operation of College Observatory to produce geomagnetic and seismic data for national and international use	Branch of Electromagnetism and Geomagnetism College Observatory 800 Yukon Drive Fairbanks, AK 99701 (907) 479-6146
Turner, B. W., and Thrasher, G. P.	--	Minerals Management Service	Southern	Mapping shallow geologic features, eastern Gulf of Alaska	Alaska Regional Office 800 A Street Anchorage, AK 99501 (907) 271-4414
Turner, R. F.	Cuffy, R. J. (Penn. St. Univ.) Thrasher, G. P. Turner, B. W. Ariey, Catherine Larson, J. A. Olson, D. W.	Minerals Management Service	Southern	Taxonomy and ecology of fossil and modern Bryozoa, Gulf of Alaska	Alaska Regional Office 800 A Street Anchorage, AK 99501 (907) 271-4443
Turner, R. F., and Larson, J. A.	Olson, D. W. Flett, T. O.	Minerals Management Service	Southern	Biostratigraphy and paleoenvironment studies, Gulf of Alaska	Alaska Regional Office 800 A Street Anchorage, AK 99501 (907) 271-4443
Vallier, T. L.	(See Scholl, D. W.)				
von Heune, Roland	Fisher, M. A.	Geologic	Offshore	Studies of geologic framework and resource assessment, western Gulf of Alaska	Branch of Pacific-Arctic Geology 345 Middlefield Road, MS 99 Menlo Park, CA 94025 (415) 856-7105
Wahrhaftig, Clyde	--	Geologic	Southern	Evaluation of coal in central Alaska Range	Branch of Alaskan Geology 345 Middlefield Road, MS 17 Menlo Park, CA 94025 (415) 323-8111 x 2664
Weber, F. R.	Foster, H. L. Hamilton, T. D.	Geologic	East-central	Studies of glacial history, Yukon-Tanana Upland	Branch of Alaskan Geology Box 80568 Fairbanks, AK 99708 (907) 474-7245

Table 3. - Listing of project chiefs, associated personnel, and brief description of project work -- Continued

Project Chief	Associated Personnel	Organizational Designation	Region of Operation	Type of Work	Mailing Address and Telephone Number
White, E. R.	--	Geologic	Statewide	Information, procurement, and publication services	Technical Data Unit Alaskan Geology Branch 345 Middlefield Road, MS 48 Menlo Park, CA 94025 (415) 323-8111 x 2342 or 2684
White, E. R.	Coonrad, W. L. Salem, B. B.	Geologic	Statewide	Design and implementation of bibliographic computer data base for materials available from Tech. Data and for earth science literature on Alaska	Technical Data Unit Alaskan Geology Branch 345 Middlefield Road, MS 48 Menlo Park, CA 94025 (415) 323-8111 x 2342 or 2684
Wilcox, D. E.	--	Water Resources	Southern	Study of trace metals in surface water, Healy and Lignite Creek basins	Fairbanks Subdistrict Office 101 12th Avenue, Box 11 Fairbanks, AK 99701 (907) 456-0214
Wilcox, D. E.	Hopkins, G. C. Krumhardt, A. P.	Water Resources	East-central	Geohydrologic studies, Fairbanks North Star Borough	Fairbanks Subdistrict Office 101 12th Avenue, Box 11 Fairbanks, AK 99701 (907) 456-0214
Williams, J. R.	--	Geologic	Southern	Mapping surficial deposits of south-western Copper River basin	Branch of Alaskan Geology 345 Middlefield Road, MS 90-B Menlo Park, CA 94025 (415) 323-8111 x 4130
Williams, J. R.	Kachadoorian, Reuben Ferrians, O. J., Jr. Ovenshine, A. T. Sloan, C. E.	Geologic	Statewide (corridor)	Provides advice to agencies responsible for plan and design review, natural gas pipeline	Branch of Alaskan Geology 345 Middlefield Road, MS 90-B Menlo Park, CA 94025 (415) 323-8111 x 4130
Wilson, F. H.	Shew, Nora	Geologic	Statewide	Geochronological and petrologic studies (AMRAP)	Branch of Alaskan Geology Gould Hall, APU Campus University Drive Anchorage, AK 99504 (907) 278-3571
Winkler, G. R.	Barker, Fred Burns, L. E. Grantz, Arthur Karl, S. M. Miyaoka, R. M. Bruhn, R. L. (Univ. of Utah) Pessel, G. H. (State of AK, DGGS)	Geologic	Southern	Mineral-resource assessment, Anchorage quadrangle (AMRAP)	Branch of Alaskan Geology Gould Hall, APU Campus University Drive Anchorage, AK 99504 (907) 278-3571

Table 3. -- Listing of project chiefs, associated personnel, and brief description of project work -- Continued

Project Chief	Associated Personnel	Organizational Designation	Region of Operation	Type of Work	Mailing Address and Telephone Number
Wood, S. H.	--	Geologic	Southern	Tectonic tilt measurements in southern Alaska	Branch of Earthquake Tectonics and Risk Boise State University Boise, ID 83702 (208) 385-1631
Yeend, W. E.	--	Geologic	Statewide	Investigations of placers	Branch of Alaskan Geology 345 Middlefield Road, MS 17 Menlo Park, CA 94025 (415) 323-8111 x 2541
Yehle, L. A.	(See Schmoll, H. R.)				
York, J. E., (EROS) and Till, A. B. (Geol. Division)	Orr, D. Trautwein, C.	EROS Field Office	West-central	Development of geologic data base for Bendeleben and Solomon quadrangles	EROS Field Office 218 E Street Anchorage, AK 99401 (907) 271-4065

Many of the Survey's programs and projects in Alaska are planned with and funded by other Federal, State, and local agencies. The Survey enters into these formal cooperative agreements to improve information-gathering abilities and when such cooperation is advantageous to the agencies and to the public. In many situations, the cost of the project is shared equally by the Survey and the cooperator. These cooperative programs are reviewed annually to assure that they continue to be responsive to current needs of the agencies and the public. The table below lists FY 1982 cooperators in Alaska.

Table 4. -- Cooperating Agencies  
[Federal cooperators within the same division as the project are not listed.]

Federal	State	Local	Project Title	Project Chief	Organizational Designation
Dept. of Agriculture, Forest Service; U.S. Army Corps of Engineers, Cold Regions Research and Engineering Laboratory (CRREL)	Depts. of Natural Resources (ADNR), Div. of Geol. and Geophys. Surveys (DGGS); Fish and Game; Transportation and Public Facilities; Environmental Conservation; Alaska Power Authority (APA)	Municipality of Anchorage; Kenai Peninsula Borough; Fairbanks North Star Borough; City and Borough of Juneau	Collection of Basic Records Program (surface water, ground water, water quality)	Division personnel	Water Resources
Bureau of Land Management (BLM); Minerals Management Service; U.S. Fish and Wildlife Service; U.S. Army Corps of Engineers, CRREL	Univ. of Colorado, Institute of Arctic and Alpine Research		Arctic Alaska Landsat Land-Cover Mapping	Gaydos, L. J.	National Mapping
Forest Service; BLM	Univ. of Alaska; ADNR		Operation of IDIMS in Vegetation Classification	Carneggie, D. M.	EROS Field Office
U. S. Army, Chief of Engineers; Dept. of Interior (DOI)			Alaska Natural Gas Transportation System	Williams, J. R.	Geologic
National Oceanic and Atmospheric Administration (NOAA); U.S. Army Corps of Engineers, CRREL	Univ. of Alaska		Alaska Seismic Studies	Lahr, J. C.	Geologic
BLM Outer Continental Shelf Environmental Assessment Program; NOAA			Marine Geology Program	Rowland, R. W.	Geologic
U.S. Fish and Wildlife Service			Land-Cover Mapping of Kenai and Togiak National Wildlife Refuges	Carneggie, D. M., Shasby, M. B.	EROS Field Office

**Table 4. -- Cooperating Agencies -- Continued**  
 [Federal cooperators within the same division as the project are not listed].

Federal	State	Local	Project Title	Project Chief	Organizational Designation
DOI			Water Resources of the North Slope	Sloan, C. E.	Water Resources
DOI, Office of the Secretary			ANILCA Maps, Boundary Series	Fordham, R. E.	National Mapping
BLM			Alaska Orthophoto Products	McLaurin, J. D., Fordham, R. E.	National Mapping
Office of National Petroleum Reserve in Alaska (ONPRA)			North Slope Petroleum Program	Bird, K. J.	Geologic
Minerals Management Service			Geologic Framework and Resource Assessment of the Aleutian-Bering Sea Region	Marlow, M. S.	Geologic
Environmental Protection Agency (EPA)			Hydrologic Studies Related to Coal Mining	Wilcox, D. E.	Water Resources
NOAA, National Oceanic Survey			Alaskan Bathymetric and Topographic Maps	McLaurin, J. D.	National Mapping
NOAA			National Petroleum Reserve in Alaska Data Open File	Gryc, George	ONPRA
ONPRA			Geochemistry of Oilfield Waters, National Petroleum Reserve in Alaska	Kharaka, Y. K.	Water Resources
ONPRA; Minerals Management Service			Brooks Range Devonian Clastic Rocks	Brosge, W. P.	Geologic
Minerals Management Service			Northern Alaska Engineering Geology	Ferrians, O. J., Jr.	Geologic
U.S. Army Corps of Engineers, CRREL, AK District			Sediment Transport in the Tanana River in the Vicinity of Fairbanks	Burrows, R. L.	Water Resources
Bureau of Mines			Chugach National Forest (RARE II)	Nelson, S. W.	Geologic
	ADNR, DGGS		Lower Cook Inlet-Shelikof Strait Field Program, 1980	Smith, T. N., Petering, G. W.	Minerals Management Service
	DGGS	Kenai Peninsula Borough; Municipality of Anchorage	Ground-water Stations	Nelson, G. L.	Water Resources



**Table 4. -- Cooperating Agencies -- Continued**  
 [Federal cooperators within the same division as the project are not listed].

Federal	State	Local	Project Title	Project Chief	Organizational Designation
	Univ. of Alaska, Geophysical Inst.		Effects of Date and Phenology on Classification of Alaska Vegetation Using Landsat Data	Lauer, D. T.	EROS Field Office
	DGGS		Techniques of Hydrologic Assessment for Planning and Management in Alaska	Madison, R. J., Parks, Bruce	Water Resources
	DGGS		Earthquake Hazards Mapping, Anchorage-Susitna Lowlands	Ferrians, O. J., Jr.	Geologic
	DGGS		Lower Cook Inlet Stratigraphic Study	Bolm, J. G., Lyle, W. M.	Minerals Management Service
	DGGS		Alaska Mineral Resource Appraisal (AMRAP)	Winkler, G. R.	Geologic
	DGGS		Knik Glacier Study	Mayo, L. R.	Water Resources
	Pennsylvania State Univ.		Taxonomy, Ecology, and Bathymetric Distribution of Fossil and Recent Bryozoa, Kodiak Shelf, Gulf of Alaska	Turner, R. F.	Minerals Management Service
	DGGS		Chilkat Basin Hydrology	Bugliosi, E. F.	Water Resources
	DGGS		Copper River Basin Hydrology	Emery, P. A.	Water Resources
	DGGS		Chuitna Coal Area Study	Nelson, G. L.	Water Resources
	DGGS		Ground-Water Observation Well Network	Nelson, G. L.	Water Resources
	DGGS		Mount Spurr Hydrologic Hazards Study	Emanuel, R. P.	Water Resources
	APA		Total Sediment Transport below Devils Canyon Dam Site on Susitna River	Knott, J. M.	Water Resources
		Municipality of Anchorage	Geohydrology of the Anchorage Area and Chester Creek Study	Brabets, T. P.	Water Resources
		Fairbanks North Star Borough	Geohydrology of the Fairbanks Area	Wilcox, D. E.	Water Resources
		Matanuska-Susitna Borough	Ground-Water Investigation, Point MacKenzie	Patrick, L. D.	Water Resources





