ALASKA'S RESOURCE INVENTORY 1984

Compiled by W.W. Barnwell and K.S. Pearson

SPECIAL REPORT 36

Published by

STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGICAL AND GEOPHYSICAL SURVEYS
1984

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Fairbanks, Alaska
1984

STATE OF ALASKA

DEPARTMENT OF NATURAL RESOURCES

Bill Sheffield, *Governor*
Esther C. Wunnicke, *Commissioner*
Robert D. Arnold, *Deputy Commissioner*
James K. Barnett, *Deputy Commissioner*
Ross G. Schaff, *State Geologist*

FOREWORD

In 1983, the Alaska Division of Geological and Geophysical Surveys (DGGS) distributed more than 60,000 publications about Alaska's natural resources in response to information requests from 50 of the United States and more than 20 foreign countries.

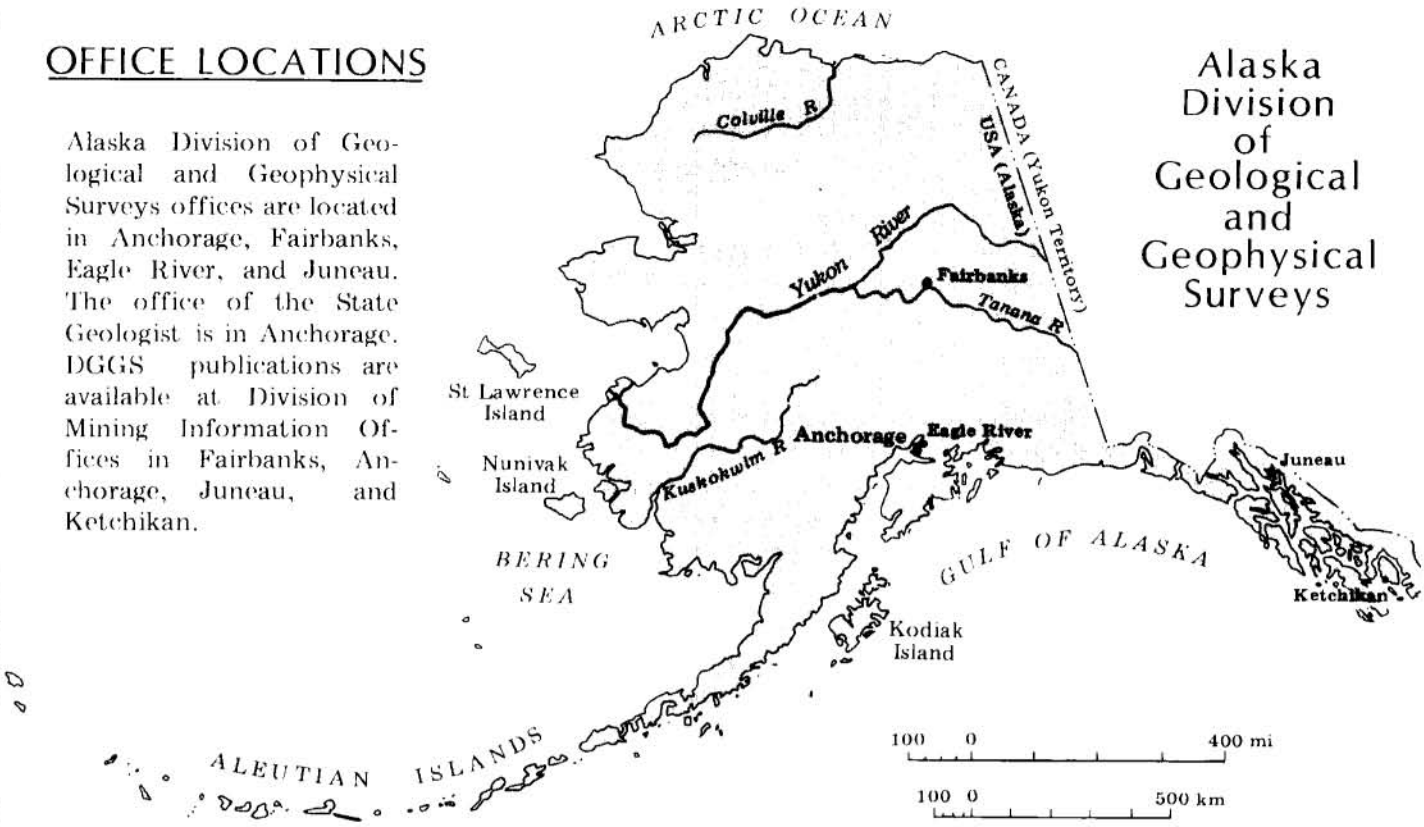
The Division has responded to hundreds of thousands of inquiries since its creation in 1972—inquiries that span the spectrum of resource information that we are mandated by both the legislative and executive branches of government to provide. We answer questions about engineering geology and about oil-and-gas, minerals, sand-and-gravel, water, coal, peat, geothermal, soil, and timber resources. There are basic commonalities, however, to most of these requests. What resources do we have? Where are they located? What is the magnitude of their potential? What are the environmental conditions? What is the level of information available for management and policy decisions? What is the State of Alaska doing to enlarge its natural-resource data base?

This report was designed as a general response to these common questions. At the same time, it provides a perspective on the present state of our knowledge of Alaska's resources and outlines the activities of the Alaska Division of Geological and Geophysical Surveys and its continuing pursuit of the natural-resource inventory of the 49th state.

Ross G. Schaff
State Geologist

OFFICE LOCATIONS

Alaska Division of Geological and Geophysical Surveys offices are located in Anchorage, Fairbanks, Eagle River, and Juneau. The office of the State Geologist is in Anchorage. DGGS publications are available at Division of Mining Information Offices in Fairbanks, Anchorage, Juneau, and Ketchikan.



CITY	OFFICE LOCATION	PHONE NUMBER	STAFF AND SERVICES
Anchorage	Frontier Building 3601 C Street, Suite 800 Pouch 7-028 Anchorage, Alaska 99510	907-276-2653	State Geologist Archaeology Data processing Oil and gas Resource analysis Timber
	Division of Mining 3601 C Street, Suite 1008 Pouch 7-005 Anchorage, Alaska 99510	907-786-2205	Publications sales
Eagle River	Fish Hatchery Road P.O. Box 772116 Eagle River, Alaska 99577	907-688-3555	Alaska Materials Center Engineering geology Water
Fairbanks	Bank of the North Building 794 University Avenue, Basement Fairbanks, Alaska 99701	907-474-7147	Coal Engineering geology Geothermal energy Minerals Peat Sand and gravel Soils Publications sales
	O'Neill Resources Building, Room 203 University of Alaska Fairbanks, Alaska 99701	907-479-7122	Public Assay Laboratory
Juneau	State Office Building 400 Willoughby Center, 3rd floor Juneau, Alaska 99801	907-465-3400	Legislative assistance Minerals Publications sales
Ketchikan	Division of Mining State Office Building P.O. Box 7348 Ketchikan, Alaska 99901	907-225-4181	Publications sales

CONTENTS

MAPS

INTRODUCTION

The Alaska Division of Geological and Geophysical Surveys (DGGS) is administratively located by Alaska Statutes 41.08.010-.040 in the Department of Natural Resources (DNR) and has four broad, long-term goals to guide its activities.

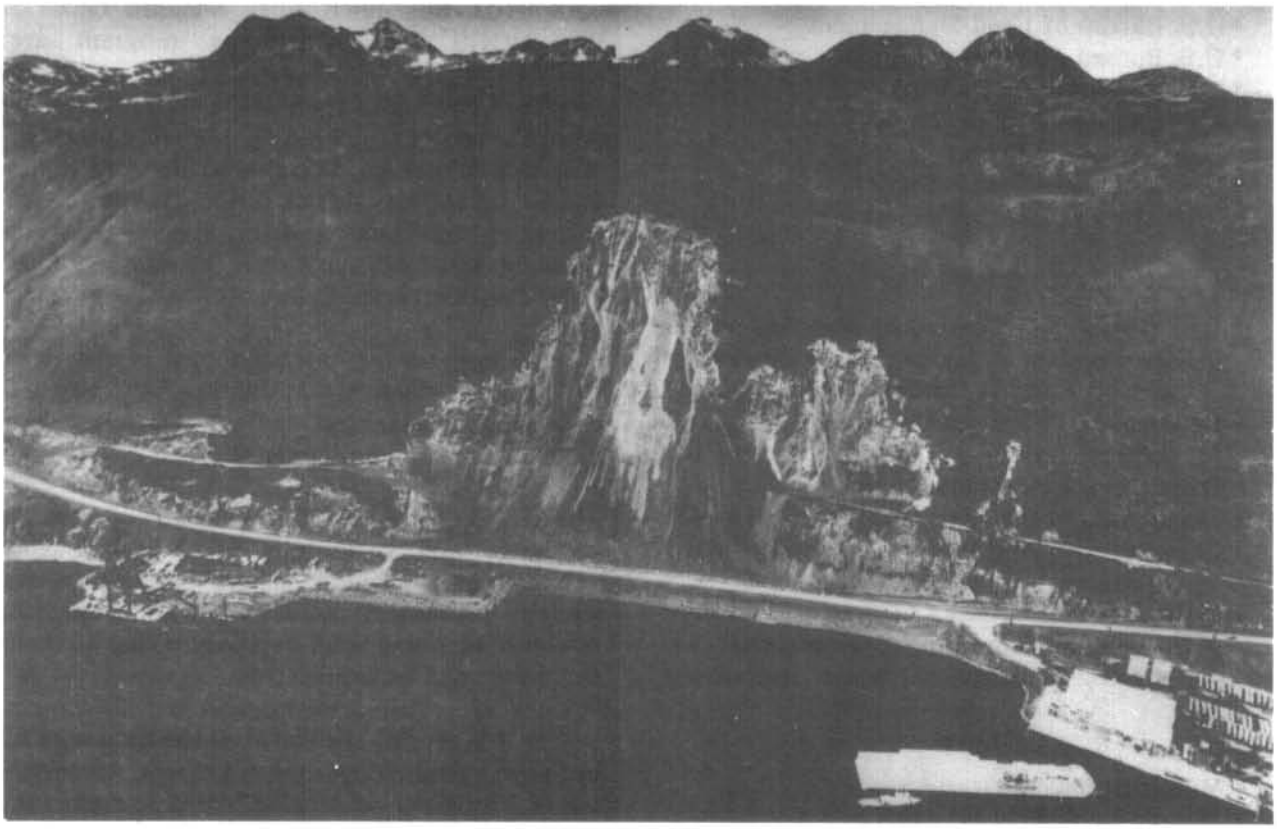
Economic vitality: Help assure and contribute to the vitality of Alaska's economy.

Quality of life: Help ensure that Alaskans have the opportunity to enjoy the quality of life they desire.

Natural-resource stewardship: Use and conserve Alaska's natural resources in ways that produce the greatest long-term benefits for the people of the State.

Informed decisionmaking: Achieve the previous three goals with minimal conflict by following a responsible and responsive decisionmaking process that is based on the best resource information obtainable, balanced consideration of all the social and economic factors involved, and informed public participation.

The primary role of DGGS is to assist the Department in meeting these goals by collecting pertinent data, by analyzing these data, and by translating these data into information that can be used in management and policy decisions. Consequently, the objectives, programs, and activities of the Survey are directly linked to the objectives, programs, and activities of each management division in the Department. Fortunately, most information the Survey provides to the Department is also information that is requested by industry, other government agencies, and the general public. As an example, the DGGS water-data program is designed in direct response to the information needs of the Division of Land and Water Management, which appropriates Alaska water on behalf of the Department. These same data, however, are used by the Departments of Environmental Conservation, Fish and Game, and Transportation and Public Facilities. The data and information are



Unstable Pillar Mountain poses a potential hazard to the City of Kodiak (right foreground). Slope-stability studies were conducted by DGGS from 1978 to 1980 as part of a larger cooperative program to evaluate the hazard potential to the City and Borough of Kodiak. Other participants in this study included the U.S. Geological Survey, the U.S. Army Corps of Engineers , the City and Borough of Kodiak, and the State of Alaska Departments of Community and Regional Affairs and Transportation and Public Facilities. Photograph by U.S. Geological Survey, file PIO 78-33.

also made available through DGGS publications. Thus, there is a coordinated establishment of priorities of the activities of DGGS based on the management-information needs of DNR, the results of which are systematically made available to the people of Alaska.

Funding is by annual legislative appropriation. An annual budget request is prepared, and an overall 5-year plan is updated each year. Additional funds are obtained by grants and matching programs with Alaskan communities and various state and federal agencies. Cooperative agreements are often used to meet the needs of local governments or in instances where DGGS and the cooperating agencies have common goals. Often, the cooperating agencies provide the expertise to conduct the resource inventory.

DGGS has signed or negotiated agreements with federal, state, and local agencies, including:

Federal

- U.S. Department of Agriculture
- U.S. Bureau of Land Management
- U.S. Bureau of Mines
- U.S. Department of Energy
- U.S. Fish and Wildlife Service
- U.S. Geological Survey
- U.S. Soil Conservation Service
- U.S. Army Corps of Engineers

State

- Department of Commerce and Economic Development (Alaska Power Authority and Office of Mineral Development)
- Department of Community and Regional Affairs
- Department of Fish and Game
- Department of Health and Social Services
- Department of Transportation and Public Facilities
- University of Alaska (Mineral Industry Research Laboratory, Geophysical Institute, Institute of Water Resources)

Local

- Village of Pelican
- Matanuska-Susitna Borough
- Municipality of Anchorage
- North Slope Borough
- Kodiak Borough
- City of Kodiak

The demands placed on DGGS by the Department and other government agencies, industry, and the general public present a formidable challenge to our staff. The resource data base for Alaska is woefully inadequate. In Alaska, bedrock geology is reliably mapped in only 26,265 square miles (about 4.5 percent) of the state, and surficial deposits, including sand and gravel, are reliably mapped in only 20,095 square miles (about 3.4 percent). Almost every state in the union has reliable geologic maps at a scale of 1 inch = 1 mile, and many have full coverage at larger scales such as 1 inch = ¼ mile. Some states even have the luxury of revising older maps. Similar analogies can be made for the data bases for each of Alaska's resources.

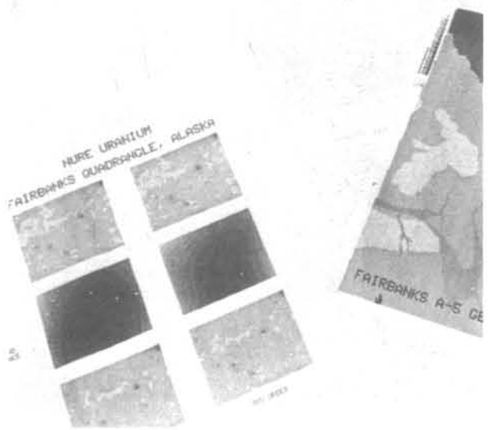
The provisions of AS 38.04.060 and AS 41.08.020 give DGGS the responsibility to provide current inventory information on Alaska's minerals and construction materials. A great deal of geologic mapping has been completed, but much work remains. Goals of the DGGS geologic-mapping program are:

- To conduct systematic inventories of Alaska's geology, including minerals and construction materials, thereby aiding and stimulating industries using these resources, encouraging informed and responsible resource management, and supporting expansion of the State's infrastructure.

- To increase our understanding of the origin of mineral deposits in Alaska, thereby encouraging exploration and development programs by the mineral industry.

- To increase our knowledge of natural processes and conditions in Alaska and to delineate areas of potential geologic constraints, thereby promoting public safety and improving land-use planning and decisionmaking in both the public and private sectors.

In this report, the status of the data base for each of Alaska's natural resources, associated issues, program objectives, and current and future projects for selected areas are described. In addition, a section on services of DGGS is included.



A specially designed computer-based data-modeling system allows DGGS to analyze geological, geochemical, and geophysical data and produce a variety of derivative maps, as shown above.

DERIVATIVE MAPS THAT UTILIZE BASIC GEOLOGIC DATA

- Potential for construction materials
- Susceptibility to landsliding (slope stability)
- Potential for liquefaction
- Susceptibility to frost action
- Foundation conditions
- Suitability for septic tanks and leach fields
- Excavation conditions
- Drainage conditions
- Ground-water availability
- Susceptibility to erosion
- Suitability for agriculture
- Potential for lode mineralization
- Suitability for residential housing

Derivative maps are special-purpose interpretive products that are developed from basic environmental maps such as geologic maps. Derivative maps, which translate scientific terminology for nonscientists, are best developed by the scientist in consultation with the user. They are often prepared using modern computer techniques, and their variety is limited only by the ingenuity of the scientist and user.

WHO USES GEOLOGIC MAPS?

GENERAL PUBLIC
- Business investment
- Home construction
- Land purchase
- Education

LOCAL GOVERNMENTS
- Hazards mitigation
- Land disposals
- Materials sales
- Zoning

MINERAL INDUSTRY
- Exploration programs
- Development programs

STATE AND FEDERAL AGENCIES
- Area planning
- Land disposal
- Materials sales
- Land selection
- Mineral-lease sales
- Park development

CONSTRUCTION INDUSTRY
- Exploration programs
- Development programs

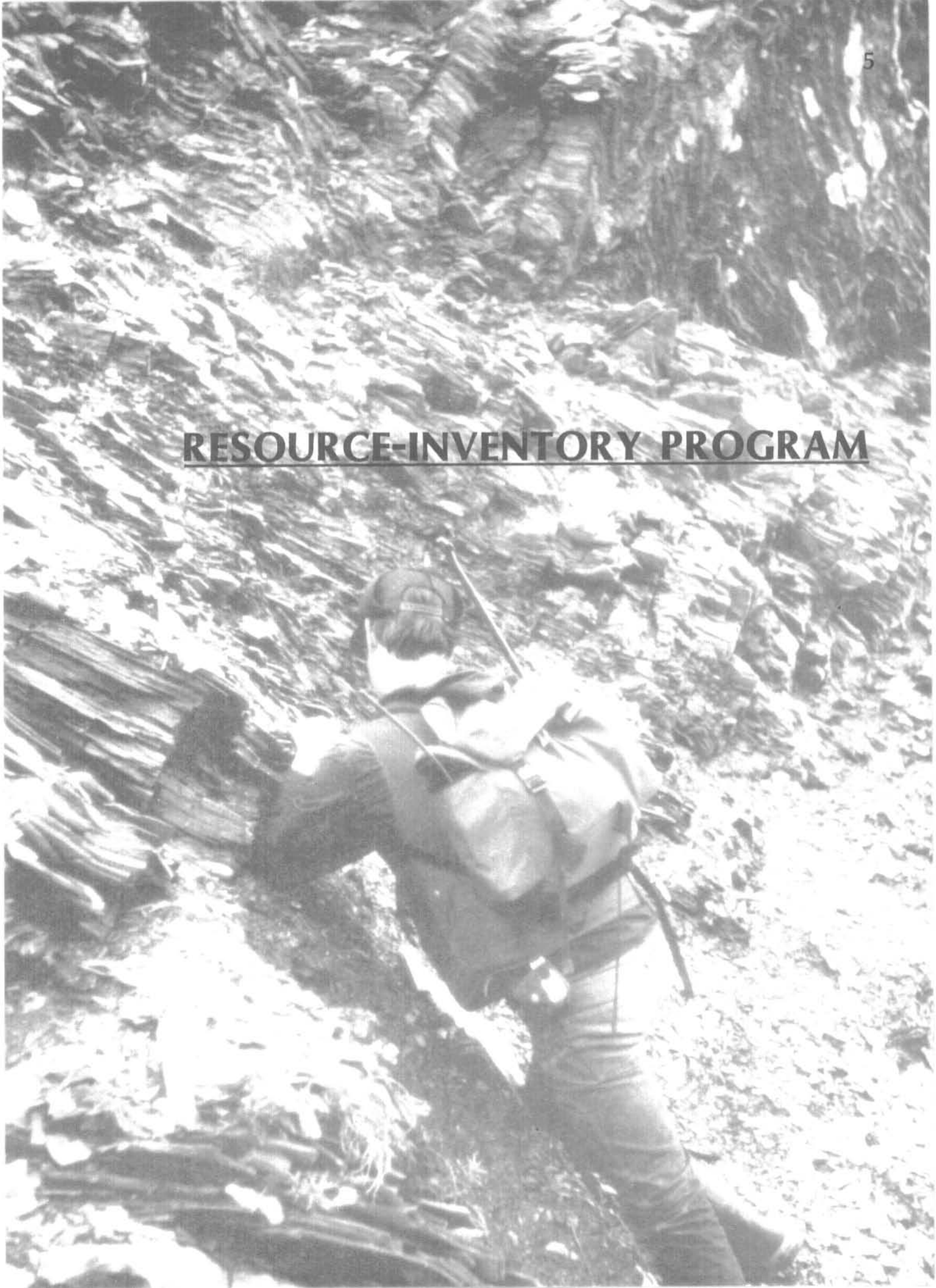
GEOTECHNICAL CONSULTANTS
- Hazards mitigation
- Foundation engineering

Geologic maps are the basic documents by which geologists communicate information and conclusions. Accurate geologic information is necessary for efficient resource utilization. Unfortunately, most of Alaska is not reliably mapped in the detail needed for this purpose.

DGGS geologist maps headwall scarp of slide on aptly named Slide Mountain west of Glennallen. Photograph by R.A. Combellick, 1982.

Compilation of map data by Division of Geological and Geophysical Surveys

Figure 1. Status of geologic mapping of Alaska, 1983.



RESOURCE-INVENTORY PROGRAM

OIL-AND-GAS RESOURCES

THE ISSUES

The presale analysis completed by DGGS is the sole means by which the state determines the hydrocarbon potential of a selected area. This information enables Department of Natural Resources petroleum economists to recommend optional bidding methods to the Commissioner. The Commissioner can then select the bidding method and lease stipulations that maximize revenue to the state. In addition, DGGS geologists and geophysicists review the hydrocarbon potential of lands proposed for disposal.

Ninety percent of Alaska's revenue is derived from royalties paid on oil-and-gas leases. Production from many Cook Inlet fields is declining, and production from the Prudhoe Bay field is expected to substantially decline in the 1990s.

Early indications from North Slope exploration are generally encouraging. Several recently discovered accumulations that are being delineated include:

- Kuparuk field: Approximately 1.2 billion barrels recoverable; currently producing over 125,000 barrels per day.

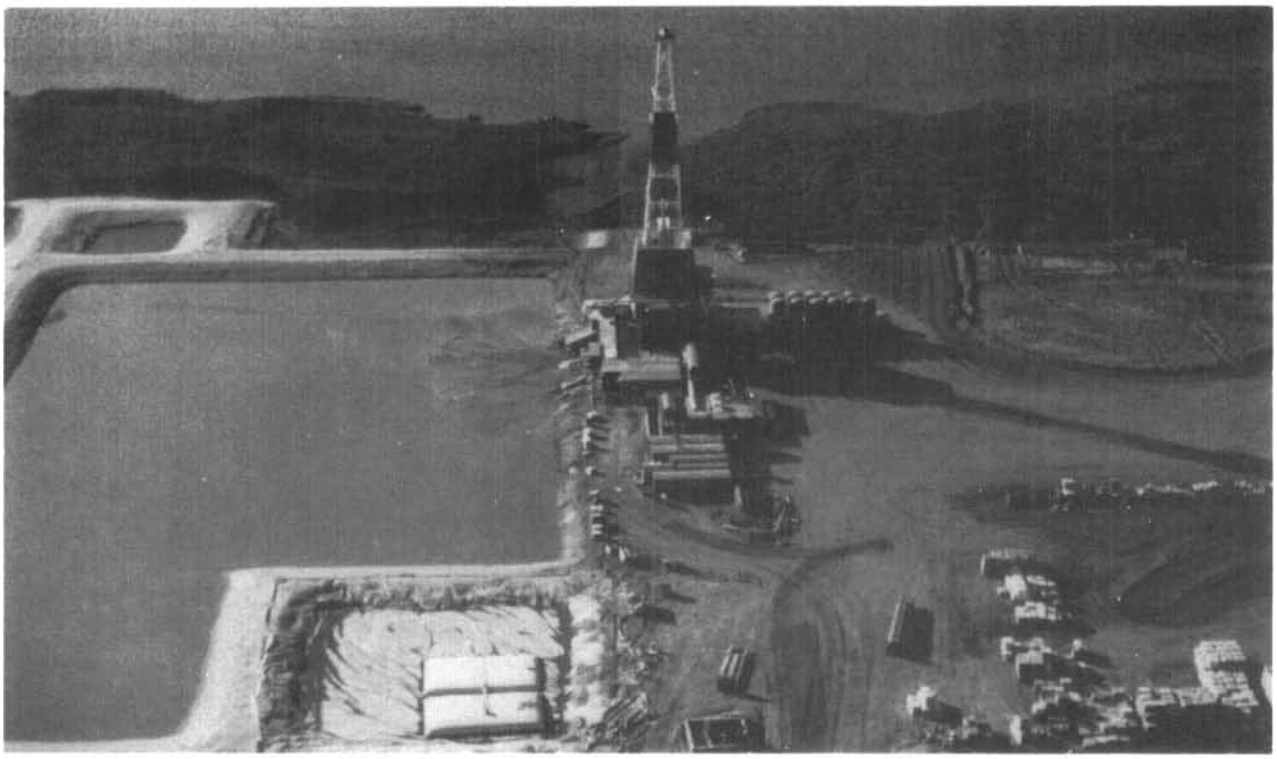
- Duck Island-Sag Delta area: 1.1 billion barrels of in-place oil with up to 350 million barrels recoverable plus an unknown quantity of free and associated gas. Production is from a rock unit that is not productive in the Kuparuk and Prudhoe Bay fields.

- Point Thomson area: Estimates of 350 million barrels of recoverable condensate (very high gravity, high-quality oil) and 6 trillion cubic feet of recoverable gas.

- Lisburne Pool: 3 billion barrels of in-place oil that underlie the producing Sadlerochit reservoir (Prudhoe Bay field); possibly 500 million barrels recoverable.

- Milne Point area: 60 million barrels of recoverable oil.

- Gwydyr Bay area: 30 million barrels of recoverable oil.



Gravel pad, containment pit, and drill rig on the North Slope near Prudhoe Bay. Photograph by S.E. Rawlinson, 1978.

• West Sak-Ugnu area: Although these shallow sands contain large reserves of heavy oil, commercial production is uncertain. Preliminary hot-water-injection projects are being conducted, and 15 to 25 billion barrels of oil are thought to be in place in the West Sak sands, with as much as 3 to 5 billion barrels ultimately recoverable. Development of the heavy oil in the shallow Ugnu sands (6 to 11 billion barrels in place) is currently beyond the technological capability of industry.

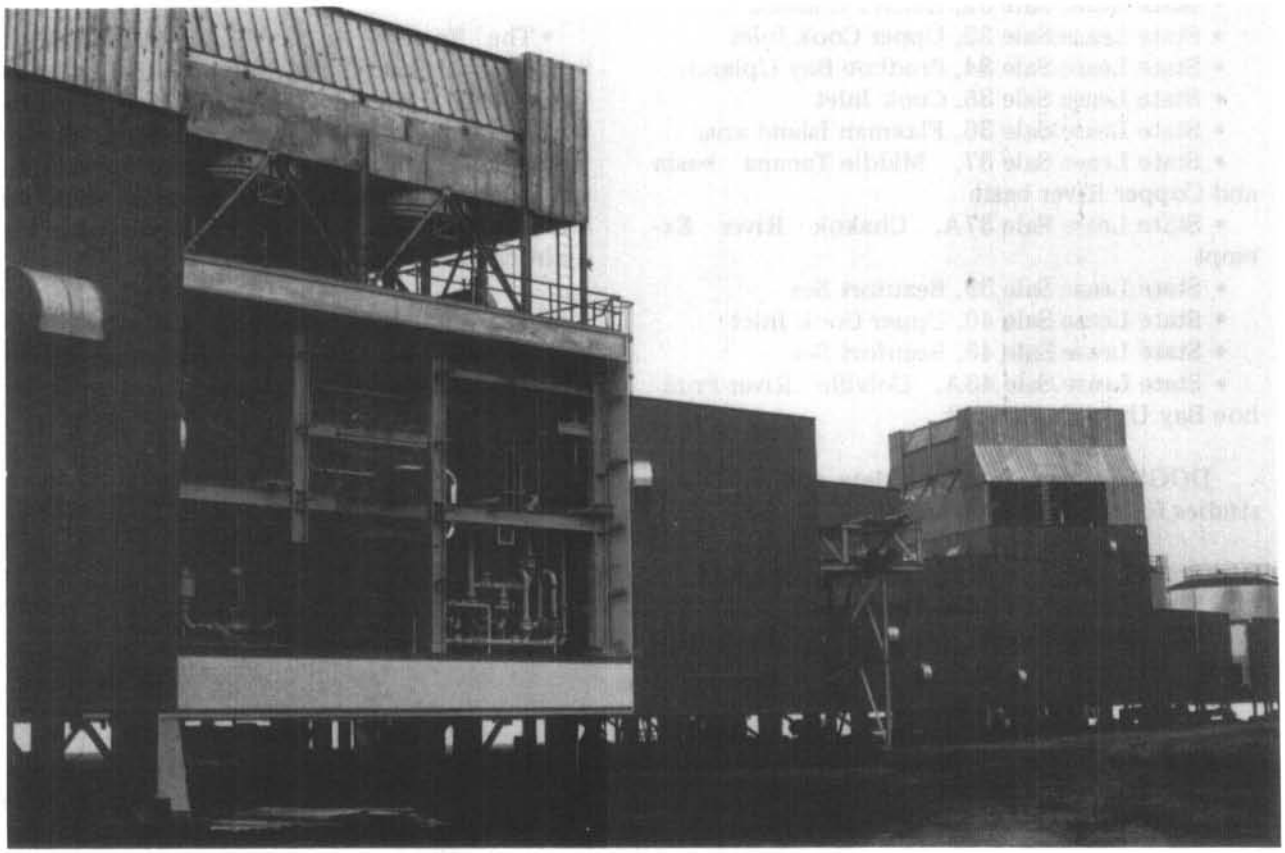
• Seal Island: Discovery well flowed up to 5,000 barrels per day of 40° gravity oil and 10 million cubic feet of gas per day. No estimate of in-place resources. Delineation wells are currently being drilled.

Although the discoveries are encouraging, further exploration and the development of many smaller fields are necessary to replace the reserves of the supergiant Prudhoe Bay field.

According to the National Petroleum Council (1981), estimates for undiscovered oil resources in Alaska are from 2.5 to 14.6 billion barrels offshore and 4.6 to 24.2 billion barrels onshore. Some resources are on state lands, and the state collects 90 percent of the royalties paid on federal leases on wildlife refuges.

Exploration on onshore and offshore state and federal leases is occurring at a moderate rate. Twelve exploratory wells were drilled from January 1983 through May 1984. During 1983 and 1984, three offshore stratigraphic tests were completed and over 10,000 miles of seismic data were acquired by industry. Current permits indicate that over 1,600 miles of seismic data will be collected this summer. Present drilling activity includes three wildcat wells near the Arctic National Wildlife Refuge on state land leased in Sale 34, three wildcat wells south of the Prudhoe Bay-Kuparuk area, and one confirmation well in the Beaufort Sea northeast of Prudhoe Bay. About seven rank wildcat wells permitted in the St. George and Norton federal offshore basins will probably be drilled during 1984.

Development activity is extensive in both known fields, and delineation wells are being drilled in newly discovered accumulations. The past year also saw extensive expenditures by



Flow-station building modules that were offloaded at Prudhoe Bay West Dock during the 1978 sealift await transport to the construction site. Photograph by S.E. Rawlinson, 1978.

industry for a variety of enhanced oil-recovery projects and experimental pilot injection projects. A $750 million enhanced (tertiary) recovery program in a small part of the Prudhoe Bay field will add 115 million barrels of recoverable oil to the field reserves.

PROGRAM OBJECTIVES

- To provide information on oil-and-gas resources to help assess and contribute to the economic vitality of the state.

- To analyze the oil-and-gas potential of lease-sale areas so that the state can maximize revenues from the lease sales and from any subsequent oil production.

- To conduct regional geologic surface and subsurface investigations that will provide information to assist in determining land exchanges and disposals.

CURRENT PROJECTS

Presale analyses have been completed for the following areas:

- State Lease Sale 32, Kenai Peninsula
- State Lease Sale 33, Upper Cook Inlet
- State Lease Sale 34, Prudhoe Bay Uplands
- State Lease Sale 35, Cook Inlet
- State Lease Sale 36, Flaxman Island area
- State Lease Sale 37, Middle Tanana basin and Copper River basin
- State Lease Sale 37A, Chakok River Exempt
- State Lease Sale 39, Beaufort Sea
- State Lease Sale 40, Upper Cook Inlet
- State Lease Sale 43, Beaufort Sea
- State Lease Sale 43A, Colville River-Prudhoe Bay Uplands Exempt

DGGS is also obtaining data and initiating studies for the following areas:

- State Lease Sale 41, Bristol Bay Upland
- State Lease Sale 46A, Cook Inlet
- State Lease Sale 47 and 48, Kuparuk Uplands
- Killik River-Chandler Lake area (C.G. Mull, project manager)
- Minchumina Basin, joint geologic and seismic study (M.W. Henning, J.F. Meyer, project managers)
- Holitna Basin, joint geologic and seismic study (T.N. Smith and J.F. Meyer, project managers)

FUTURE PROJECTS

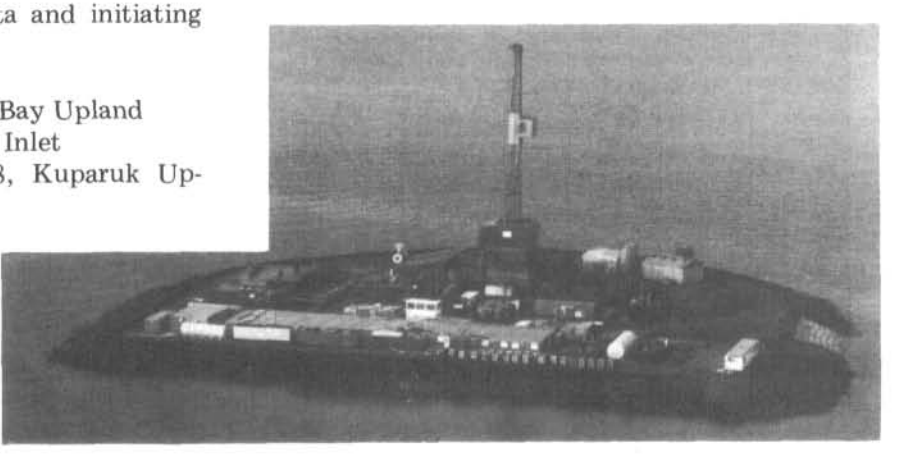
DGGS will continue to provide detailed, state-of-the-art, presale analyses under the state's 5-year leasing program.

- Due to the extreme importance of the North Slope of Alaska as a world-class petroleum province and the likelihood that many future discoveries will occur in this area, DGGS will conduct regional geologic and geophysical studies that will aid in lease-tract analyses and hydrocarbon resource-revenue projections.

- The Killik River-Chandler Lake-De Long Mountain areas will be studied to generate structural and rock data necessary to understand the evolution of the North Slope petroleum province.

- The Eastern North Slope Basin Analysis project will study the North Slope basin between the Colville River and the Canadian border, including the Arctic National Wildlife Refuge. This project will integrate surface and subsurface information to provide structural and reservoir data on specific areas with high hydrocarbon potential.

- An oil-and-gas resource analysis of the coastal area of the Arctic National Wildlife Refuge is tentatively scheduled.



Duck-2 Island (near Prudhoe Bay) was constructed in 1982 for exploratory drilling. Photograph from Ensearch Corporation, 1983.

U.S. GEOLOGICAL SURVEY RESOURCE ASSESSMENT AREAS

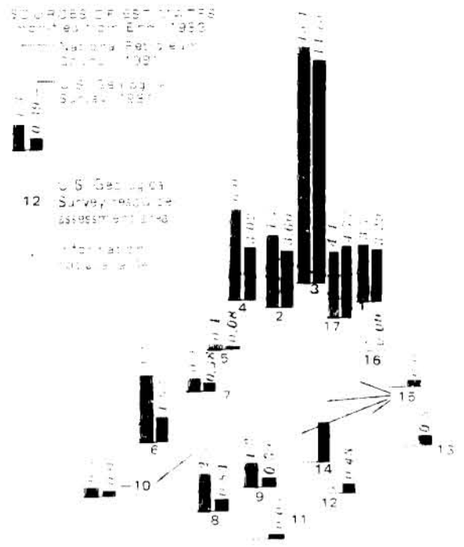
No.	Area
1	Arctic National Wildlife Refuge
2	National Petroleum Reserve-Alaska
3	Beaufort Sea
4	Chukchi Sea
5	Hope
6	Navarin
7	Norton
8	St. George-Unimak Plateau
9	North Aleutian
10	Bering Sea (other)
11	Shumagin
12	Kodiak Shelf
13	Gulf of Alaska
14	Cook Inlet-Shelikof Straits
15	Copper River (other)
16	Yakutat (other)
17	North Slope (other)

STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES
Division of Oil and Gas
Oil and gas lease sale status

No.	Area	Date
32	Kenai Peninsula (general)	Aug 1988*
33	Upper Cook Inlet (general)	May 1981*
34	Prudhoe Bay subarea	Sept 1981
35	Cook Inlet (general)	Dec 1981*
36	Shumagin (general)	May 1982
37	Middle Ground Shoal and Trading Bay East	Aug 1982
37A	Chinook Unit Exempt	Aug 1982
39	Beaufort Sea	Feb 1983
40	Lower Cook Inlet	Sept 1983
41	Bristol Bay (general)	Sept 1984
43	Beaufort Sea	May 1984
43A	Duck Island Unit Exempt	May 1984
45	Hope Basin	May 1985
45A	Kuparuk River Unit Exempt	Aug 1985
46	Norton Basin	Apr 1986
46A	Cook Inlet (Kenai Peninsula)	Sept 1986
47	Kuparuk River Unit	Dec 1986
48	Kuparuk River Unit	May 1987
49	Prudhoe Bay Unit	May 1988
50	Lisburne Unit	Sept 1988
51	Duck Island Unit	Sept 1988
52	Beaufort Sea	Sept 1988
53	Point Thomson	Dec 1988
54	Kuparuk River Unit	Apr 1989
55	Lisburne Unit	May 1989
56	Navarin Basin	Sept 1989
57	Beaufort Sea	Dec 1989
58	Kuparuk River Unit	Apr 1990
824	Bureau of Land Management	1990
•	Beaufort Sea	Sept 1988
•	Chukchi Sea	Dec 1988
•	Barrow Arch	Dec 1988
•	Other	1989-1990

Petroleum Basins (general location)

No.	Area	Date
83	Navarin Basin	Mar 1989
85	Cook Inlet	Feb 1988
86	Shumagin	June 1988
87	Diapir Field	June 1988
88	Cook Inlet-Gulf of Alaska	Oct 1984
89	St. George Basin	Dec 1988
92	N. Aleutian Basin	Apr 1985
97	Diapir Field	June 1988
99	Kodiak	Oct 1986
100	Norton Basin	Oct 1985
101	St. George Basin	Dec 1988
107	Navarin Basin	Mar 1986
109	Barrow Arch	Feb 1987



POPULATION CENTERS – Number of inhabitants, 1980

Anchorage ● 174,431
Fairbanks ● 22,645
Juneau ★ 19,528 (state capital)
• 2,000-8,000

SELECTED TRANSPORTATION-UTILITY CORRIDORS (═══)

Scale 1:12,000,000

100 0 100 200 300 400 mi

100 0 100 200 300 400 500 km

824 Bureau of Land Management

85 Minerals Management Service general location

DOGGS OIL AND GAS INVENTORY PROJECTS

Basin

Play

MINERAL RESOURCES

THE ISSUES

Alaska has important reserves of base metals, such as copper, lead, and zinc, as well as strategic and critical minerals, including tin, tungsten, platinum, antimony, mercury, chromium, nickel, and asbestos. So far, eight 'world-class' deposits, each containing more than $1 billion in strategic or other important minerals, have been found. Since 1979, mineral production has doubled in Alaska, and development expenditures have tripled.

A serious impediment to development of Alaska's nonrenewable resources is the lack of detailed geologic information needed to encourage further exploration, promote development of known resources, and properly manage the land. Only 4.5 percent of Alaska's bedrock geology has been mapped at the detailed (1:63,360) scale that mining companies and government agencies need for effective mineral development (see fig. 1 for extent of reliable geologic mapping in Alaska).

PROGRAM OBJECTIVES

- To provide detailed and reliable geologic maps that will help locate and evaluate mineral resources, particularly strategic minerals.

- To provide the public, business, and government with reliable information on minerals that will promote sound decisions on mineral development and use.

- To maintain an annual summary of the activities of the mineral industry in Alaska.

CURRENT PROJECTS

Bedrock geologic mapping and mineral-resource assessments are proceeding in many areas of Alaska, including:

- Southern Brooks Range (J.T. Dillon, project manager)
- Yukon-Tanana Upland (T.E. Smith, project manager)
- Kokrines Hills (J.T. Dillon, project manager)
- Upper Kuskokwim River (T.K. Bundtzen and J.T. Kline, project managers)
- Lower Kuskokwim River (John Decker, project manager)
- Central Chugach Mountains (G.H. Pessel, project manager)
- Central Talkeetna Mountains (G.H. Pessel, project manager)
- Haines-Klukwan area (W.G. Gilbert, project manager)

DGGS is compiling aeromagnetic maps at scales of 1:63,360 and 1:250,000 (John Decker, project manager).

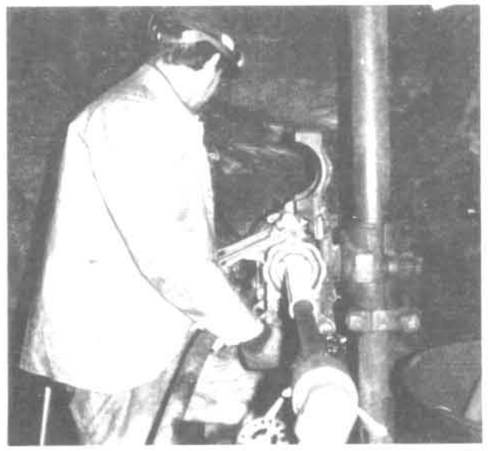
Detailed analysis and interpretation of geochemical data using a computer-based geological-data-modeling system is gaining increased importance for accurately defining areas of high mineral potential in Alaska. The products of these efforts are incorporated in bedrock mapping and mineral-assessment reports (M.A. Wiltse, project manager).

DGGS geologist measures bedding attitudes near Windy Fork, McGrath Quadrangle. Photograph by D.N. Solie, 1981.

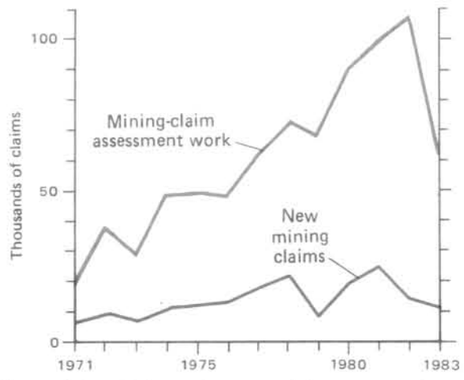
FUTURE PROJECTS

Quadrangle mapping and detailed studies of mineral deposits are tentatively scheduled for the following areas during the next 5 years:

- Haines-Klukwan
- Southern Talkeetna Mountains
- Ophir district
- Iditarod district
- Lime Hills district
- Bethel district
- Yukon-Tanana Upland
- Eastern Seward Peninsula
- De Long Mountains
- Dalton Highway corridor

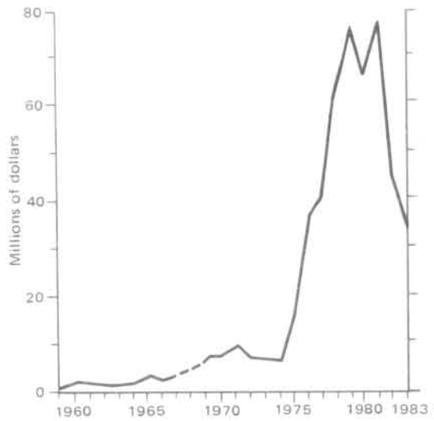


Longyear 47 underground diamond-drilling program, Clipper Mine, Fairbanks district. Photograph by K. Greig, 1983.

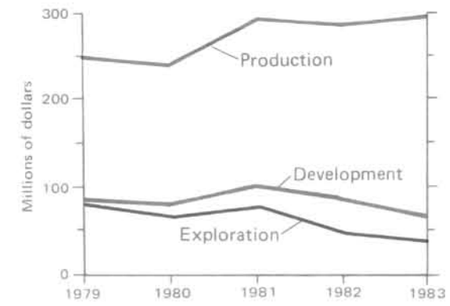


New mining claims and mining-claim assessment work filed in Alaska, 1971-83 (modified from Bundtzen and others, 1984).

Known world-class mineral deposits in Alaska.



Mineral–exploration expenditures in Alaska, 1959-83 (modified from Bundtzen and others, 1984).



Value of mineral activity in Alaska, 1979-83 (modified from Bundtzen and others, 1984).

Compilation of map data by Division of Geological and Geophysical Surveys

Figure 3. Status of DGGS inventory of mineral resources of Alaska, 1984.

SAND-AND-GRAVEL RESOURCES

THE ISSUES

Sand and gravel are the most heavily mined materials in Alaska. In 1983, $120 million worth of sand and gravel was mined, compared to $67 million worth of gold and $18 million worth of coal.

Sand and gravel are essential for construction of roads and buildings. In some areas of Alaska, such as the Copper River basin, the supply of sand and gravel is inadequate to meet immediate needs.

Only 3.4 percent of Alaska has been geologically mapped at a scale adequate to pinpoint sand-and-gravel resources. A benefit of surficial-geologic maps at 1:63,360 scale is the identification of the locations of suitable construction materials. Because surface materials are related to geologic constraints such as frozen ground, mapping of these materials also increases our knowledge of geologic hazards.

Sources of suitable construction materials must be identified early in the planning process to ensure adequate supplies for future development. In areas of limited or diminishing sand-and-gravel supplies, knowledge of the location of these resources is essential for making informed land-use decisions. Most remaining sand-and-gravel resources in Anchorage, for example, are inaccessible because the land was developed for uses that preclude quarrying. As a result, most sand and gravel must be shipped by train from the Matanuska Valley at a cost of $1.65 per ton (1982 price).

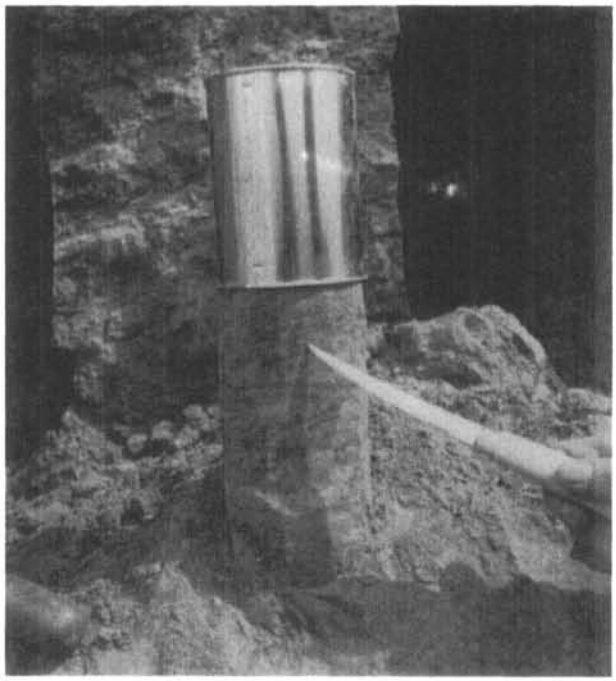
PROGRAM OBJECTIVES

- To provide detailed and reliable reconnaissance estimates of the quantity and location of Alaska's sand-and-gravel resources.

- To provide the public, industry, and government with information on sand and gravel that will help them make sound decisions on development and land use.

CURRENT PROJECTS

- Prudhoe Bay (S.E. Rawlinson, project manager)
- Eastern Yukon-Tanana Upland (T.E. Smith, project manager)
- McGrath-Iditarod-Lime Hills districts (T.K. Bundtzen and J.T. Kline, project managers)
- Northern Chugach Mountains (G.H. Pessel, project manager)
- Turnagain Arm near Anchorage (R.A. Combellick, project manager)
- Haines-Klukwan (W.G. Gilbert, project manager)

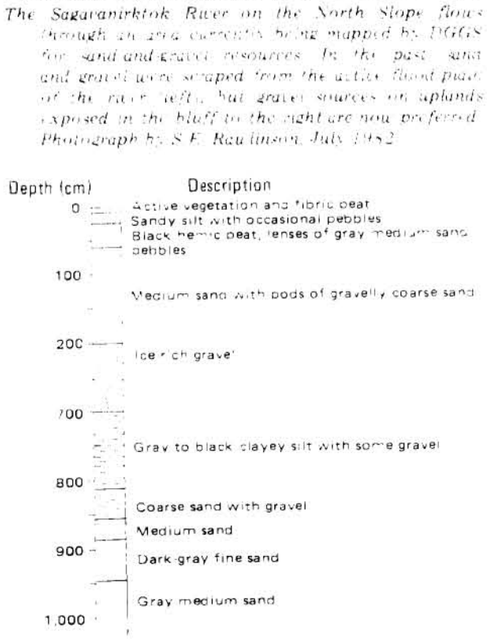


DGGS geologist trims and cans a column of windblown silt (loess) to protect the undisturbed sample during shipment to the laboratory for analysis. Loess near Delta Junction contains a 3500-year-old layer of volcanic ash that is used to date associated deposits. Photograph by R.D. Reger, 1976.

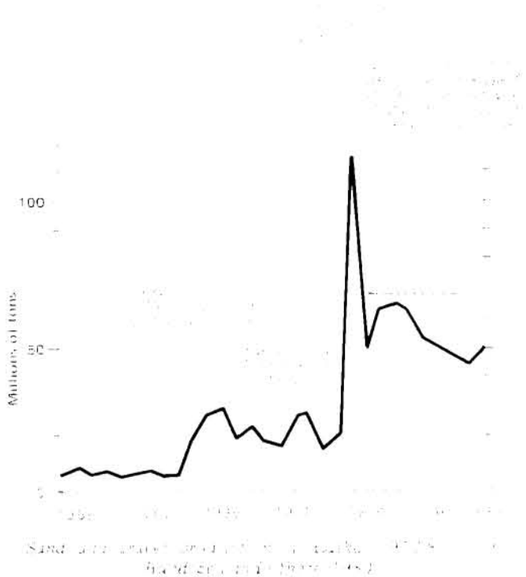
Quadrangle mapping of surficial geology is tentatively scheduled for the following areas during the next 5 years.

- Dalton Highway corridor
- De Long Mountains
- Eastern Seward Peninsula
- Fairbanks-Nenana area
- Eastern Yukon-Tanana Upland
- Ophir district
- Iditarod district
- Lime Hills district
- Bethel district
- Southern Susitna River valley
- Northeastern Arctic coastal plain

The Sagavanirktok River on the North Slope flows through an area currently being mapped by DGGS for sand and gravel resources. In the past, sand and gravel were scraped from the active flood plain of the river (left), but gravel sources on uplands exposed in the bluff to the right are now preferred. Photograph by S.E. Rawlinson, July 1982.



Vertical distribution of sand and gravel in the Sagavanirktok River bluff shown in above photograph



Gravel pit excavated in 1979 at the Kuparuk oil field, North Slope, Alaska. Sand and gravel from this pit were used during the early stages of field development. Photograph by S.E. Rawlinson, August 1981.

Compilation of map data by Division of Geological and Geophysical Surveys

POPULATION CENTERS--Number of inhabitants, 1980

Anchorage ● 174,431
Fairbanks ● 22,645
Juneau ★ 19,528 (state capital)
● 2,000-8,000

SELECTED TRANSPORTATION-UTILITY CORRIDORS (═══)

EXPLANATION

POTENTIAL FOR SAND-AND-GRAVEL DEPOSITS

Extensive areas with known moderate to high potential for sand and gravel

DGGS GEOLOGIC-MAPPING PROJECTS THAT PROVIDE INFORMATION ON LOCAL SAND-AND-GRAVEL RESOURCES

Current

Proposed

Figure 4. Status of DGGS inventory of sand-and-gravel resources of Alaska, 1984.

WATER RESOURCES

THE ISSUES

Although Alaska contains over 17,000 square miles of glaciers, innumerable lakes, and six of the 30 largest rivers in the United States, water is not always available to meet the needs of Alaskans. Other water problems include local contamination by concentrations of naturally occurring chemicals such as arsenic or pollution by human activity.

Hydrologic information is needed to plan water use by villages, industry, small businesses, and homeowners. Often, development of an area is restricted or delayed by inadequate hydrologic data.

According to the Alaska Water Use Act (1966), "the waters are reserved to the people for common use." Water rights are allocated through the DNR Division of Land and Water Management. Alaska statutes that define agency duties state that DGGS will "collect, record, evaluate, and distribute data on the quantity, quality, and location of underground, surface, and coastal waters of the state." State law also requires that DGGS collect information on water wells drilled by private contractors. This information is stored in the U.S. Geological Survey WATSTORE file that is accessible to DGGS. These data are invaluable to the prospective landowner or developer for determining local water availability.

Because watersheds are shared by diverse landusers, cooperation between private and public landowners is needed to plan and achieve optimal use of surface and ground water. Likewise, cooperation between governmental agencies that deal with water resources is highly desirable. The Alaska Water Resources Evaluation program (AWARE) is a cooperative effort between DNR, the U.S. Geological Survey, and other government agencies that collect, interpret, and distribute information on the quality and quantity of surface, subsurface, and coastal waters. Copies of the current 5-year AWARE plan are available and can be obtained from both DGGS and the Division of Mining Information Offices.

Under the Alaska Statehood Act, Alaska is entitled to the beds of all navigable waterways and the natural resources on and under the beds of those water bodies. DGGS is providing the State Attorney General with information on the physical characteristics of water bodies in Alaska. These data will be used to defend the state's navigability selections.

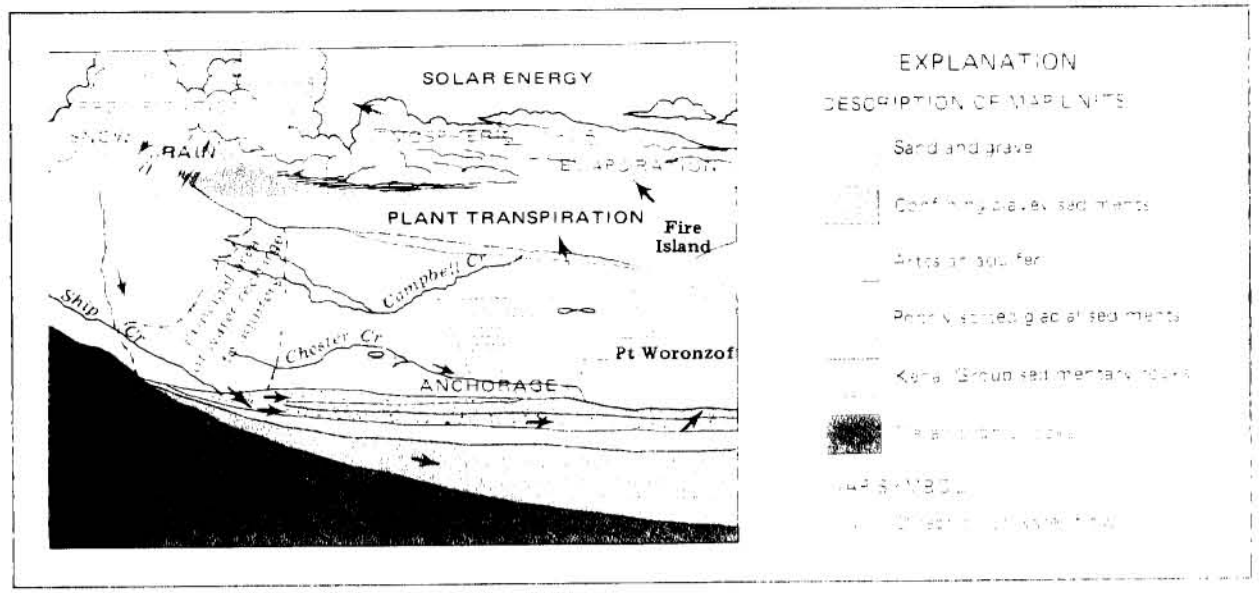
PROGRAM OBJECTIVES

- To collect information needed to determine and evaluate the quantity, quality, and use of Alaska's water resources.

- To distribute water information through reports, maps, computerized information services, and other forms of public release.

- Through the AWARE program, to coordinate the water-research activities of state and federal agencies.

DGGS hydrologist visits test well in the Nenana agricultural area to service a water-level recorder. Photograph by L.L. Dearborn, 1983.



The hydrologic cycle related to the Anchorage area aquifers (from Rain, [illegible])

CURRENT PROJECTS

- Eagle River aquifer study, to map the subsurface geology, identify ground-water flow systems, and assess the effects of increasing water use in Eagle River (J.A. Munter, project manager).

- Matanuska Valley ground-water data, including well-data compilation and publication of the existing data base (L.L. Dearborn, project manager).

- Mendenhall Peninsula-Auke Bay ground-water study, to investigate ground-water quality to define sea-water intrusion into the bedrock aquifer (L.L. Dearborn, project manager).

- Fairbanks uplands ground-water monitoring, to establish a ground-water-level monitoring network in Fairbanks residential areas (J.A. Munter and S.F. Mack, project managers).

- Potter Marsh basin hydrogeologic study, to provide technical assistance to water managers and to the Municipality of Anchorage (J.A. Munter, project manager).

- Water-well-log collection and processing, to update DGGS-U.S. Geological Survey computerized files of water-well data. Of about 1,200 well-logs received by DGGS in 1983, 780 were entered into the WATSTORE data-base (L.L. Dearborn, project manager).

- South-central ground-water-level monitoring (not shown on map) (L.L. Dearborn, project coordinator).

FUTURE PROJECTS

Tentatively scheduled projects include

- Matanuska Valley aquifer mapping, to delineate major aquifers and the nature of ground-water flow.

- Fairbanks uplands ground-water appraisal, to provide detailed data interpretation of ground-water movement and water-level changes in selected residential areas.

DGGS hydrologist examines drill cuttings at DGGS test-well site near Potter Marsh, south Anchorage. Photograph by E.D. Munter, 1984.

Compilation of map data by Division of Geological and Geophysical Surveys

Figure 5 Status of DGGS inventory of ground-water resources of Alaska, 1984.

CURRENT PROJECTS

- Maintenance and establishment of stream-gaging stations, in cooperation with the U.S. Geological Survey, for the following Division of Land and Water Management districts (W.E. Long, project coordinator):

  Southeastern District: Indian River, Mendenhall River, Salmon Creek, Lemon Creek, Klehini River, Reynolds Creek, Keta River, and Blossom River.

  South-central District: Anchor River, Kenai River, Nuyakuk River, Kisaralik River, Capps Creek, Chuitna River, Willow Creek, Deception Creek, and Deshka River.

  North-central District: Tanana River, Hess Creek, Caribou Creek, Phelan Creek, Kobuk River, Middle Fork Koyukuk River, Sagavanirktok River, Putuligayak River, and Wulik River.

- Nenana-Delta agricultural-area hydrological and meterological study to measure wind speed and direction, lake level, streamflow, and water-quality (S.F. Mack, project manager).

- Upper Kuskokwim River basin reconnaissance, to study the upper Kuskokwim River system, including the North Fork and Stony Rivers (R.W. Ireland, project manager).

- Beluga coal field snow survey, to evaluate snow (precipitation) in the Beluga coal field (E.J. Collazzi, project manager).

- Beluga coal field water-quality study, to assess water quality in streams in the Beluga coal field (M.A. Maurer, project manager).

- Strandline Lake-Beluga River outburst flood study, to examine glacier outburst flooding (W. E. Long, project coordinator).

- Matanuska River basin study (W.E. Long and R.W. Ireland, project managers).

- Matanuska Valley-Susitna River valley large-lake study, to measure lake level and water quality of Big Lake and Nancy Lake (G.A. McCoy, project manager).

- Birch Creek placer-mining study (G.A. McCoy, project manager).

- Potter Marsh basin hydrogeologic study, to provide technical assistance to water-management agencies and the Municipality of Anchorage (J.A. Munter, project manager).

- Mt. Redoubt-Drift River flood evaluation, to examine glacier-outburst floods of the Drift River (W.E. Long, project coordinator).

- Knik Glacier study, to study glacier-outburst floods of the Knik River (W.E. Long, project coordinator).

- Elfin Cove study, to determine if local waterflow or wind are sufficient for power generation (R.W. Ireland, project manager).

- Saxman study, to obtain streamflow data to determine if the water supply is sufficient for current and projected uses.

- Navigability defense project: Navigability reports were written for the Koyukuk River, Bristol Bay, and Arctic areas in 1983, and criteria reports (not shown on map) were written for Alaqnak River, Gakona River, Northway Lakes, Nenana River, Big Lake, Eagle River, and Alexcy and Hudson Lakes (M.G. Inghram, project manager).

FUTURE PROJECTS

Tentatively scheduled projects include:

- The operation of stream-gaging stations will continue, and new stations may be established on the Colville, Canning, and Copper Rivers.

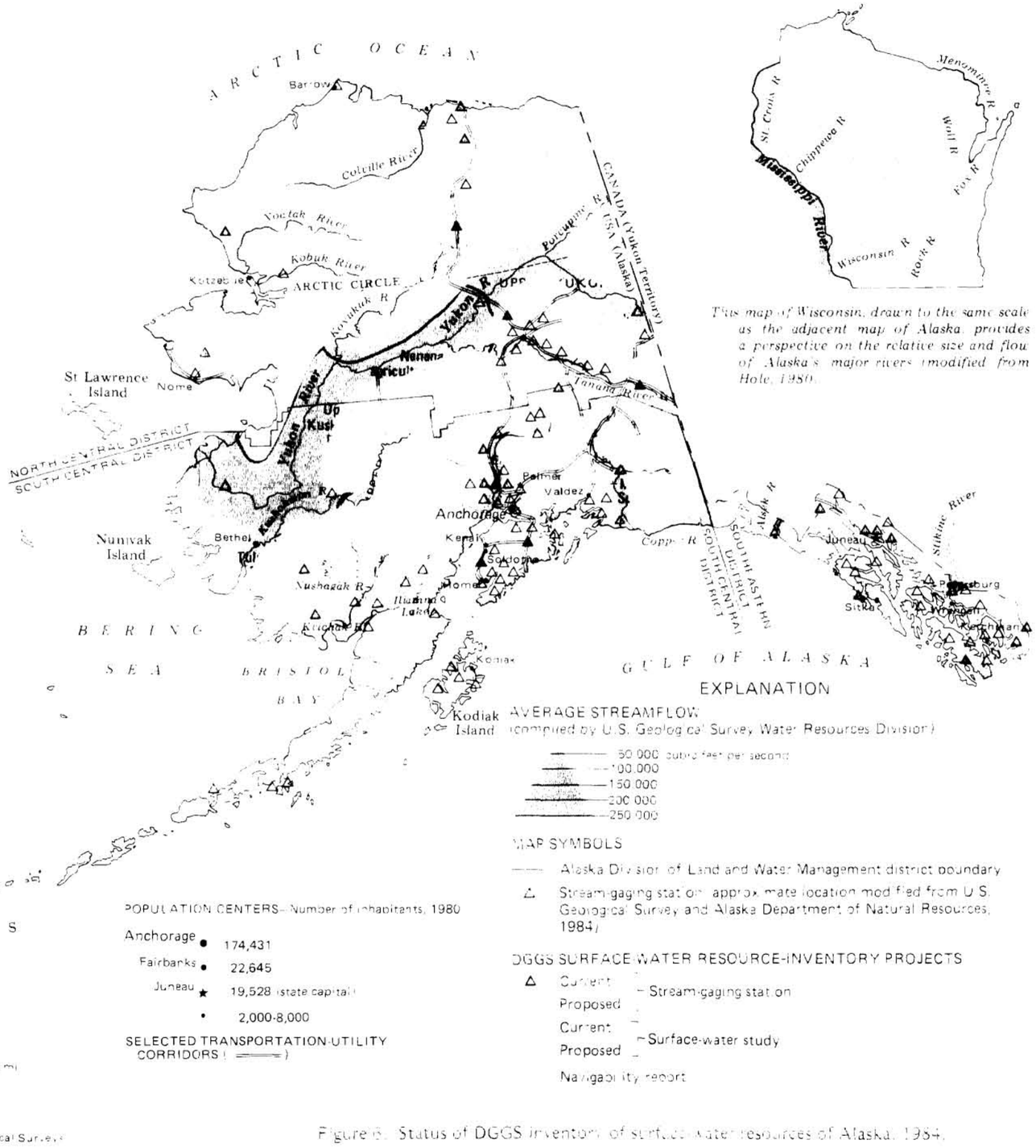
- Navigability studies will be conducted in the upper Yukon River, Kuskokwim, Tanana, and Copper River basins, and south-central and northwest areas of Alaska.

- Surface-water reconnaissance surveys are planned for the Sheenjek and Tuluksak Rivers.

- Precipitation and meteorological stations will be maintained in developing agricultural areas---particularly the Delta Junction region.

- Lake studies are tentatively scheduled for Lakes Lucille, Wasilla, and Cottonwood in the Matanuska Valley-Susitna River valley area and for Lake Louise.

- Hydrologic data are being collected and analyzed to support the Indian River Basinwide Adjudication project in the Sitka area.



This map of Wisconsin, drawn to the same scale as the adjacent map of Alaska, provides a perspective on the relative size and flow of Alaska's major rivers (modified from Hole, 1980).

Figure 6. Status of DGGS inventory of surface-water resources of Alaska, 1984.

COAL RESOURCES

THE ISSUES

Although half of the estimated United States coal resources and one-sixth of the world's coal may be present in Alaska, limited accessibility to the resource has curtailed exploration and development. At the present rate of energy consumption in the United States, Alaska contains at least a 300-year supply of coal. The Usibelli Mine (Healy), which is the only producing coal mine in Alaska, produced 803,000 short tons of coal worth $18 million in 1983.

Development of Alaska's coal reserves may provide new sources of energy for Pacific Rim nations and other states, and the export of coal to foreign nations can decrease the United States' trade deficit and provide new income for Alaska.

Marketability of coal resources is dependent upon many factors. Of primary interest to potential customers are the fundamental chemical parameters of the coal. DGGS resource assessments of Alaska coal include analyses to determine coal-combustion properties and to characterize the trace-element content of ash and other waste products. These chemical studies, which are performed by the DGGS geochemical laboratory and through cooperative agreements with the University of Alaska, have shown that Alaska's coal is uniquely low in harmful trace-element byproducts. These findings enhance the value of the state's coal relative to other world sources.

Because some rural communities are located near coal resources, for example, Kotzebue near the Chicago Creek field on the Seward Peninsula, coal could supplement or replace more expensive energy supplies in such areas.

DGGS geologist examines coal outcrop in the Nenana area. Photograph by K.M. Goff, 1982.

Royalties are paid on coal leases on state lands. Most leases are on land containing subbituminous coal, but lignitic, bituminous, and anthracitic coal deposits are also found in Alaska.

PROGRAM OBJECTIVES

- To provide land managers and coal miners with information on the quantity, quality, and location of Alaska's coal resources.

- To compile atlases showing the distribution, structure, stratigraphy, and resource estimates of Alaska coal.

- To explore the feasibility of using coal in remote villages to offset rising energy costs.

CURRENT PROJECTS

Resource investigations and compilation of coal atlases are in progress for the following areas under the Coal Field Investigations project (R.D. Merritt, project manager)

- Susitna lowland (Beluga, Capps, and Yentna coal fields)
- Nenana coal field
- Matanuska coal field
- Chignik and Herendeen Bay coal fields

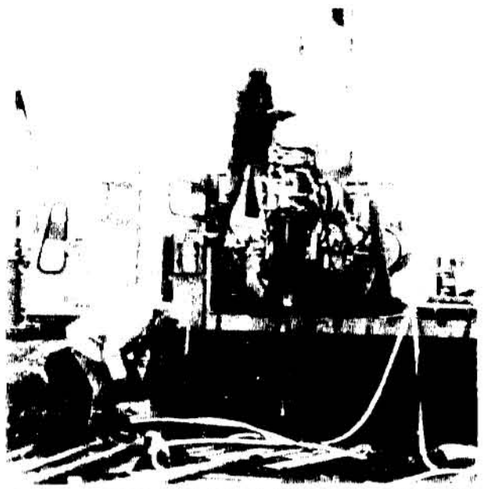
Coal occurrences that are being investigated as part of the Northwest Coal project (G.R. Eakins, project manager) include:

- Cape Beaufort
- Point Hope (Lisburne Peninsula coal field)
- Kobuk valley
- Chicago Creek
- St. Lawrence Island

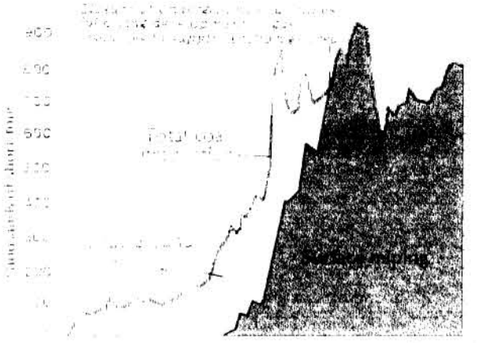
FUTURE PROJECTS

Field investigations and compilation of coal atlases are tentatively scheduled for the following areas:

- Western Nenana trend coal field
- Kenai coal field
- Bering River coal field
- North Slope coal field

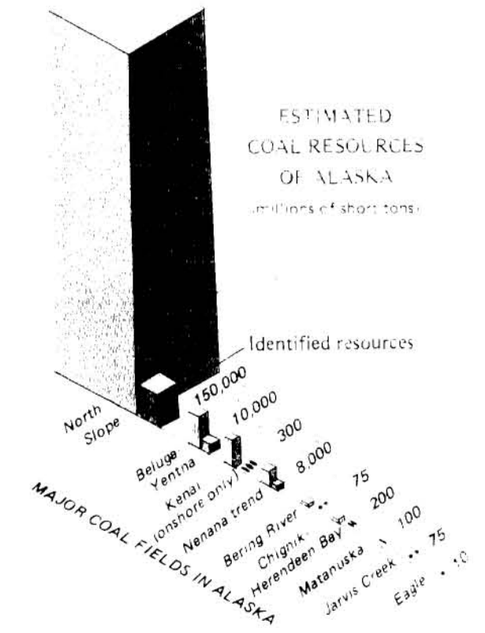


Drilling to assess coal resources in the Chicago Creek area, St. Lawrence Island. Photograph by U.S. Geological Survey, 1982.

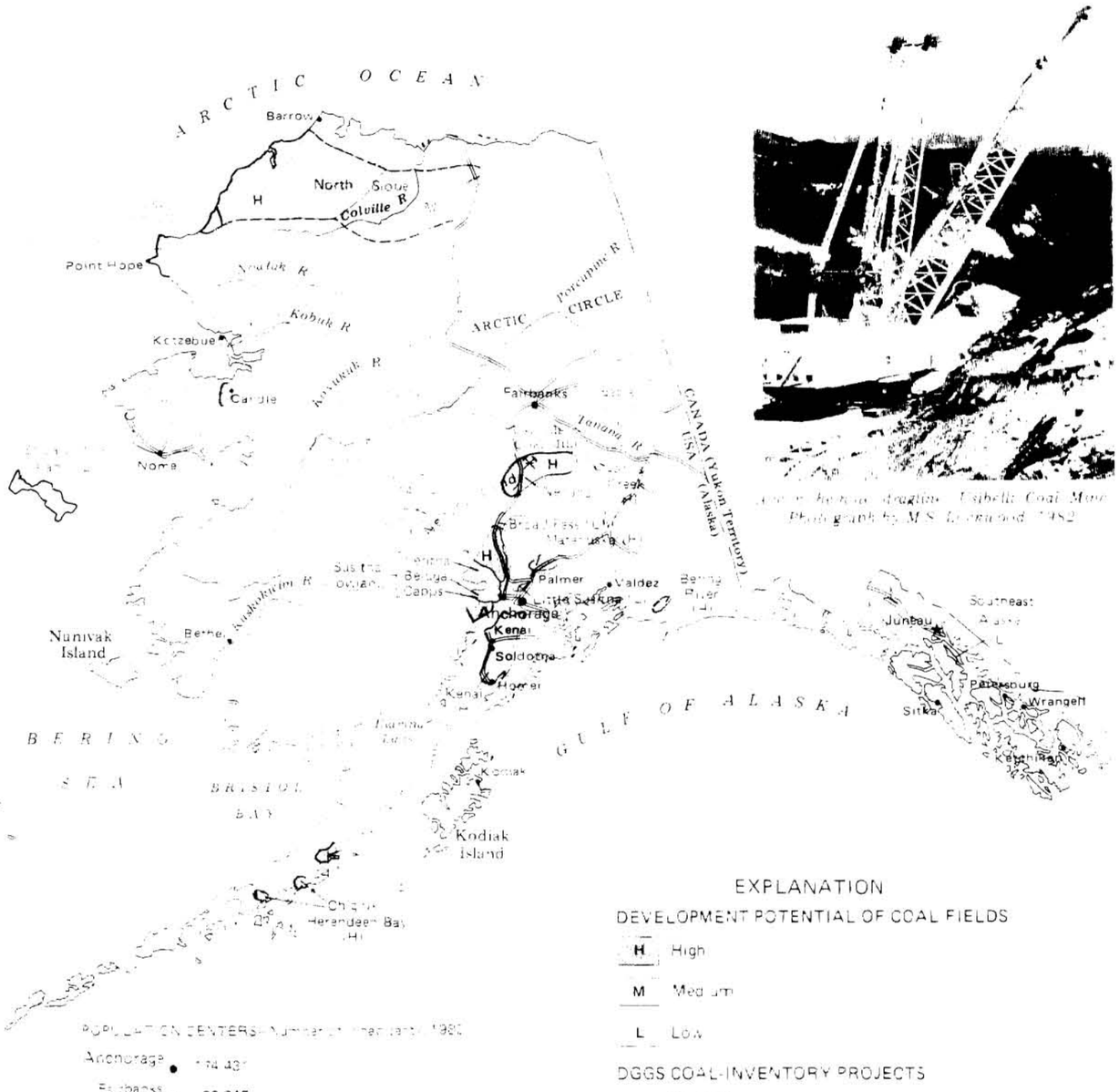


COAL RESOURCE MAPS (1984)

Coal field	Coal inventory activity
Nenana	Exploratory drilling by Placer American Corporation, Alaska
Baird River	Exploratory drilling by ADGGS
Chicago Creek	Reconnaissance drilling and continuing exploration by DGGS
Chignik-Herendeen Bay	Field work (DGGS)
Jarvis Creek	Drilling (Delta Coal Company)
Matanuska	Drilling (Valley Coal Company)
Cape Beaufort	Predevelopment drilling (Howard Grey Associates for North Slope Borough
Nenana	Production more than 300,000 short tons per year (Usibelli Mine)
Yentna	Drilling (Mobil Resources)



Alaska contains about 15 percent of the world's coal resources and about 50 percent of the coal resources of the United States. Identified resources are specific bodies of coal whose location, rank, quality, and quantity are known from geologic evidence supported by engineering measurements; hypothetical resources are unspecified bodies of coal in beds that may reasonably be expected to exist in known mining districts under known geologic conditions.



POPULATION CENTERS—Number of inhabitants, 1980

Anchorage ● 174,431
Fairbanks ● 22,645
Juneau ★ 19,528 (state capital)
• 2,000–8,000
· Selected centers less than 2,000

SELECTED TRANSPORTATION-UTILITY CORRIDORS

EXPLANATION

DEVELOPMENT POTENTIAL OF COAL FIELDS

H High

M Medium

L Low

DGGS COAL-INVENTORY PROJECTS

Current

Proposed

Scale 1:12,000,000

100 0 100 200 300 400 mi

100 0 100 200 300 400 500 km

Compilation of map data by Division of Geological and Geophysical Surveys

Figure 7. Status of DGGS inventory of coal resources of Alaska, 1984.

PEAT RESOURCES

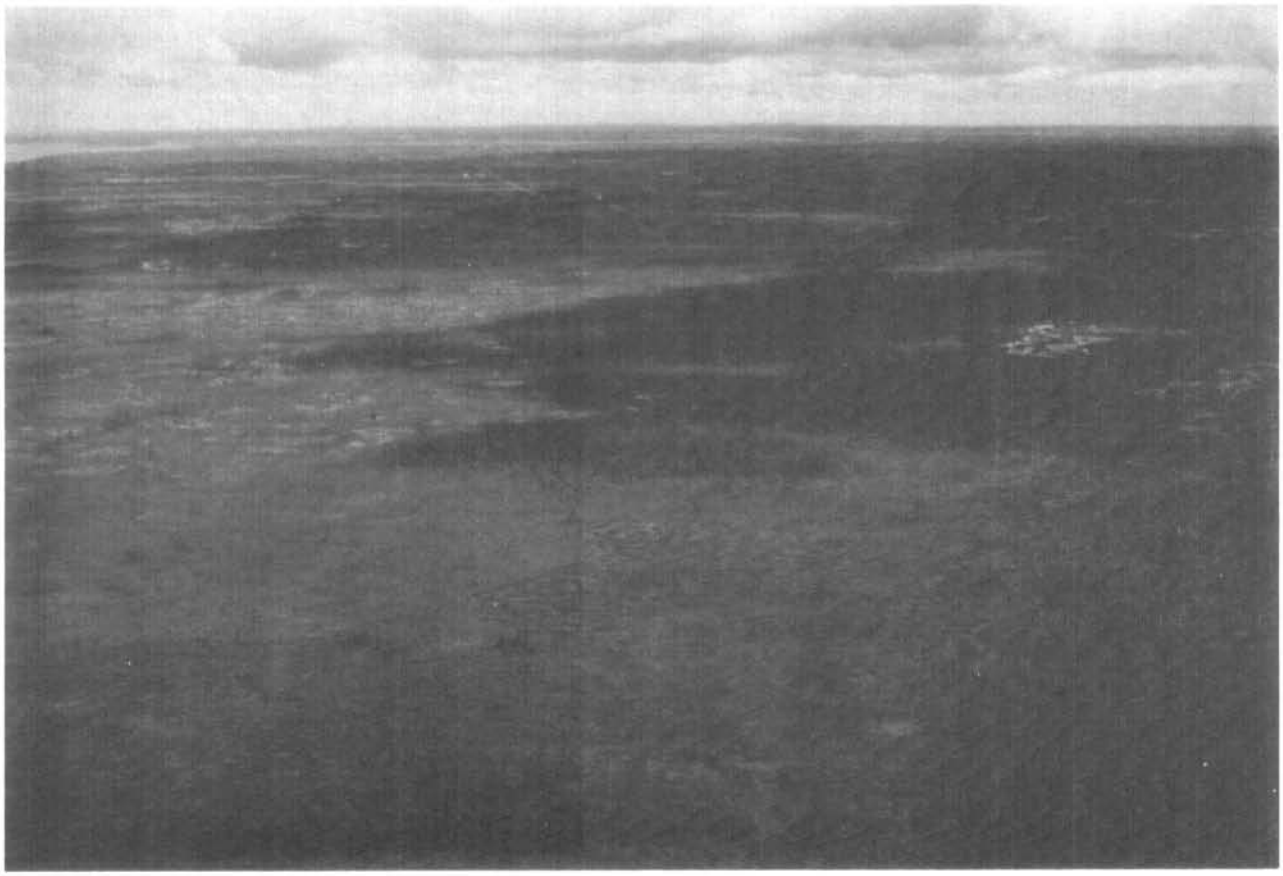
THE ISSUES

Peat is partially decomposed plant material that accumulates in an oxygen-free, water-saturated environment. Sites of peat accumulation are called bogs or peatlands. In 1982, about 10,000 cubic yards of peat were extracted from small peatlands in Alaska (primarily in the Fairbanks area) for agricultural purposes.

Although European countries, most notably the Soviet Union, Ireland, and Finland, have extracted peat for both agricultural and fuel applications for many years, the potential of Alaskan peat as a fuel has been studied only a short time. Specific criteria established by the U.S. Department of Energy (DOE) for 'fuel-grade' peat include: a) that it must produce at least 8,000 Btu per dry pound; b) that it must not include more than 25 percent noncombustible material (ash); and c) that it must be at least 5 feet thick and unfrozen to be economically viable at current market prices. The thickness and unfrozen criteria considerably reduce the percentage of Alaskan peat that is potentially fuel grade. Studies show that only about 25 percent of the potentially fuel-grade peat qualifies on the bases of noncombustible-material content and heating value.

Before 1981, estimates of Alaskan peatland with fuel-grade peat ranged from 27 million acres to over 100 million acres, and up to 741 quads (1 quad = 10^{15} Btu) of energy were estimated to be available from peat in Alaska. In 1981 and 1982, DGGS determined that about one fifth of the 25 million acres of peatland in Alaska contains potentially fuel-grade peat. Although less than 1 percent of the state's peatland was mapped during reconnaissance field work, a potential energy resource of 63 quads (on a moisture- and noncombustible-material-free basis) was estimated for the 5 million acres.

The 5-million-acre figure has since been reevaluated to 4.4 million acres, and the energy resource has been recalculated. If the minimum



Peat deposits in this peatland south of Kenai average about 8 feet thick. Photograph by S.E. Rawlinson, 1982.

fuel-grade-deposit thickness of 5 feet is assumed, 4.4 million acres of peatland will yield 1.4 x 10^{16} Btu or 14 quads, the equivalent energy of one-fourth the recoverable oil in the Prudhoe Bay oil field!

PROGRAM OBJECTIVES

- To determine the amount and location of fuel-grade peat that may be extracted and utilized in an environmentally sound manner in Alaska.

- To provide detailed and reliable geologic maps at 1:63,360 scale or larger showing areas of high fuel-grade peat potential.

- To provide the public, industry, and government with information on peat resources that will help them make sound decisions on development and land use.

CURRENT PROJECTS

DGGS Peat Assessment Program projects (S.E. Rawlinson, manager) include:

- Dillingham area: Resource investigation of selected peatlands, contracted as part of an ongoing Bristol Bay Native Association Peat Harvesting Demonstration Project; DGGS Report of Investigations in preparation.

- Roger's Creek and Houston areas, Susitna River valley: DGGS Professional Reports based on joint U.S. Geological Survey and DGGS Open-file Reports 81-1301 and 81-1302 in preparation.

- Kenai area: Professional Report based on 1982 field program in preparation.

FUTURE PROJECTS

Professional Reports based on past peat-resource field work will be prepared for the following areas:

- Susitna River valley, based on DGGS Open-file Reports 150A-M.

- Alaska Peat Resource Map, based on DGGS Open-file Report 152, scale 1:2,500,000.

DGGS geologists sample peat deposits on the Kenai Peninsula. Sample is being collected from about 15 feet below the ground surface with a McCauley sampler. Note height of rod above helicopter. Photographs by S.E. Rawlinson, 1982.

Peat collection with a McCauley sampler. Photograph by S.E. Rawlinson, 1982.

Compiled under the auspices of the Division of Geological & Geophysical Surveys

Figure 3. Status of DGGS investigations of peat resources of Alaska, 1984.

GEOTHERMAL RESOURCES

THE ISSUES

The resource potential of geothermal energy in Alaska is large, but unfortunately most accessible geothermal resources occur in rural areas, far from large energy markets. However, geothermal energy can be an attractive power-source alternative for several bush communities, particularly when the cost of transporting other fuels is considered. Geothermal energy is also being considered as a power source for remote military installations in the Aleutian Islands.

Of the 100 potential geothermal sites surveyed by DGGS, at least 20 have reservoir temperatures greater than 150°C; most remaining sites have reservoir temperatures of 90 to 150°C. Although most high-temperature sites are located in the Aleutian arc (from Mt. Spurr to Buldir Island), numerous lower temperature sites exist throughout the state, with the major concentrations in interior and southeast Alaska.

Results of DGGS fieldwork helped fund a major geothermal drilling program at Unalaska Island. DGGS assisted the Alaska Power Authority and Republic Geothermal, Inc. (the prime contractor) on the confirmation of a world-class geothermal resource near Mt. Makushin. Preliminary tests on an exploratory well indicate the geothermal field can easily supply the power needs of the Unalaska-Dutch Harbor community for the foreseeable future. The potential for finding similar geothermal fields near the Aleutian communities of Akutan and Atka is high. Sites closest to the Anchorage area that may have large high-temperature geothermal systems include Mt. Spurr and the Copper River basin west of the Wrangell volcanoes.

A geothermal drilling program administered by the Alaska Division of Energy and Power Development during 1979 and 1982 at Pilgrim Springs on the Seward Peninsula delineated a broad, shallow reservoir of 90°C water. Hot-spring waters at several localities—including Manley, Circle, Chena, Goddard, Tenakee, Baranof, and Bell Island—are currently utilized for direct-heating.

PROGRAM OBJECTIVES

- To inventory, assess, and map geothermal resources in Alaska.

- To assist federal, state, and local agencies in geothermal development and production.

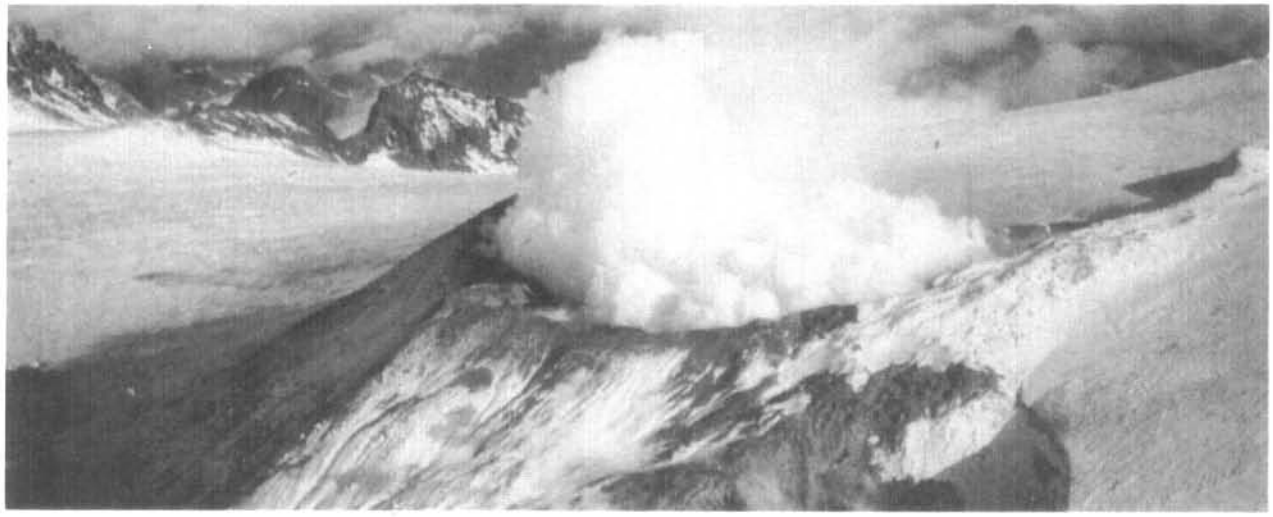
- To conduct research and explore the potential of geothermal energy.

CURRENT PROJECTS

Fieldwork in the geothermal-inventory program has been completed, and the results of this work are being compiled for publication (R.J. Motyka, project manager). Some reports on geothermal energy that are currently available from DGGS include:

- Assessment of thermal-spring sites, Aleutian arc, Atka Island to Becharof Lake—preliminary results and evaluation: DGGS Open-file Report 144.

- Assessment of thermal-spring sites in southern southeastern Alaska—preliminary results and evaluation: DGGS Open-file Report 127.

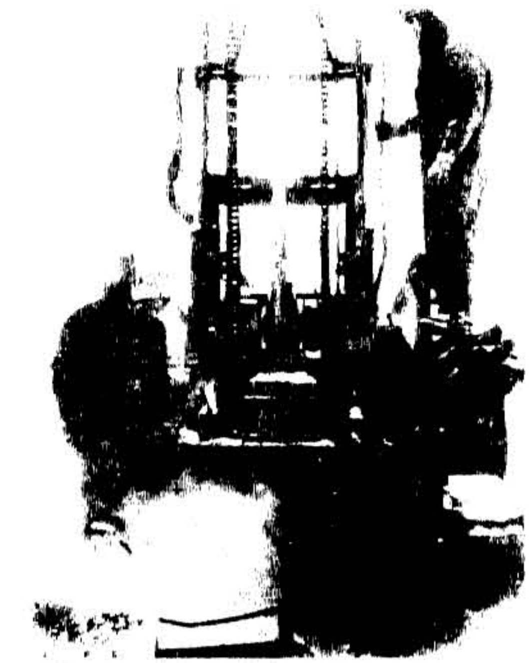


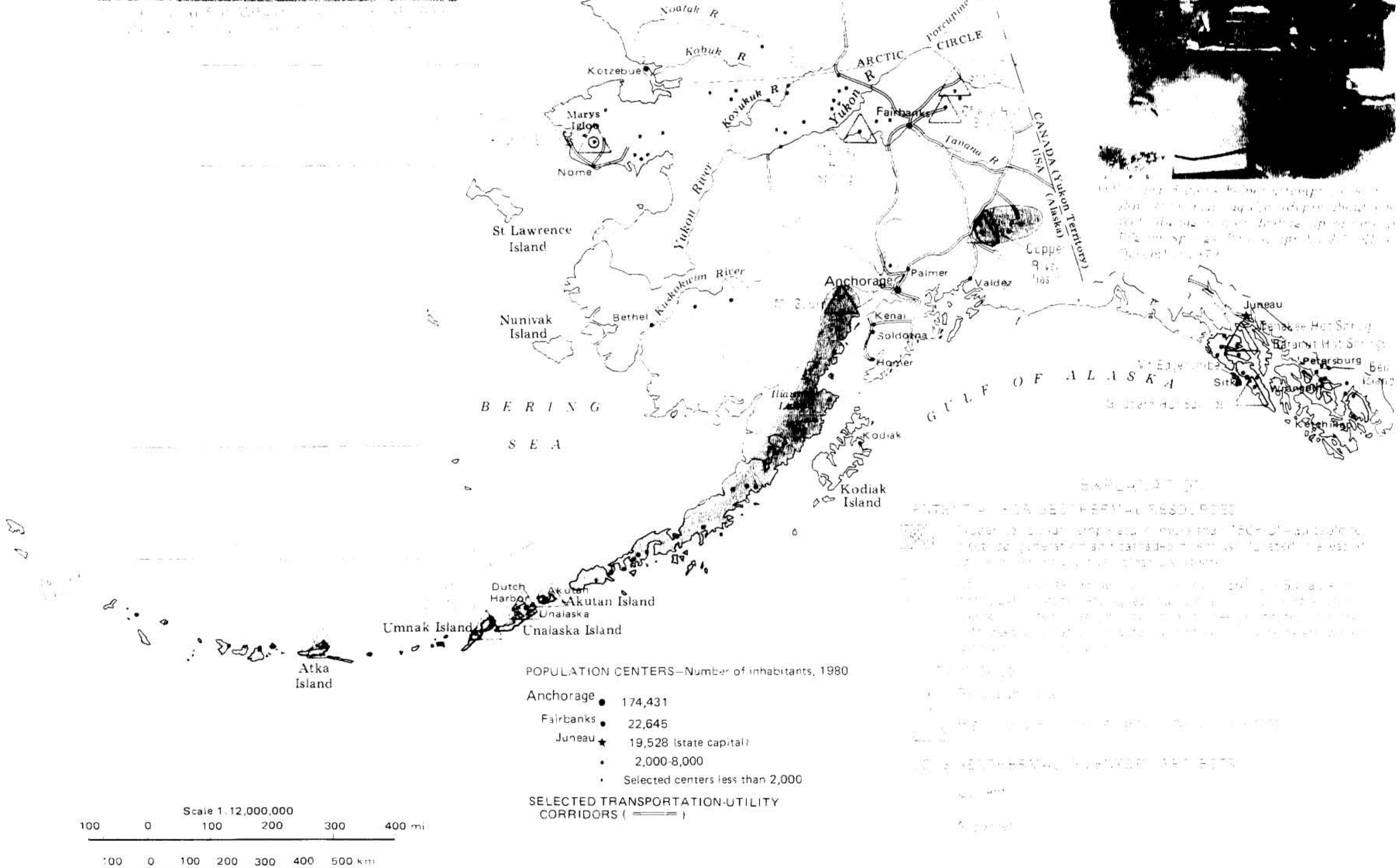
Summit fumaroles on Mt. Makushin, Unalaska Island. Photograph by Carol Clemmens, 1983.

• A geothermal ... assessment ... results of ... Pilgrim Springs, Goddard Hot Springs, the Copper River basin, and Akutan, Atka, and Umnak Islands.

FUTURE PROJECTS

• The Makushin geothermal drilling project will be completed this summer ... this significant geothermal system ... U.S. Department of Energy ...





Geologist samples fumarole on flank of Mt. Makushin, Unalaska Island. Photograph by R.J. Motyka 1982.

SOIL RESOURCES

THE ISSUES

Development of Alaska's agricultural potential is a high priority of both the administration and the legislature. Although about 20 million acres of soil in Alaska are suitable for farming, the state must import most of its food. The desire to reduce dependence on outside food sources and the willingness of the state to make farm land available have resulted in increased crop production and the cultivation of additional acreage.

Soil surveys are a key element in the selection of land for agricultural development. Reports that include maps and descriptions of agricultural soils provide important information for land-use management and allow prospective farmers to make preliminary appraisals of crop capability. Similarly, range surveys provide important information for development and management of grazing land.

PROGRAM OBJECTIVE

- To provide reliable information on the location and quality of soils in proposed agricultural and grazing areas.

CURRENT PROJECTS

Under the Cooperative Soils Surveys project (R.A. Combellick, project manager), detailed agricultural soil surveys have been completed in cooperation with the U.S. Department of Agriculture Soil Conservation Service in the following areas:

- Yentna River
- Fox River
- Mulchatna River
- Tok
- Overland Bluff
- Kobe (Rex)
- Windy
- Healy
- Deep Creek

Surveys are in progress in the following areas:

- Copper River (soil survey)
- Totchaket West (soil survey; includes the Cosna, Chitanana, Wien Lake, and Mucha Lake disposals)
- Hatcher Pass (range survey)
- Susitna (range survey)

FUTURE PROJECTS

Agricultural soil surveys are planned for:

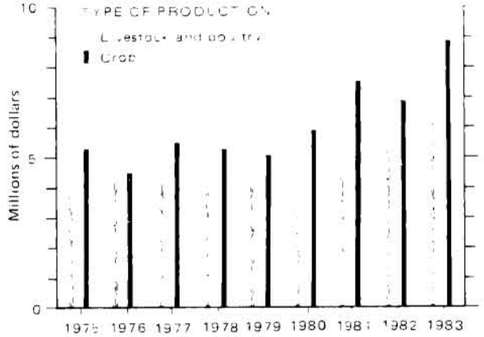
- Aggie Creek
- Clear Sky
- Middle Kuskokwim River

L. Fields' oat harvest near Sterling, Kenai Peninsula. Photograph from U.S. Department of Agriculture Soil Conservation Service, 1975.

Mowed timothy hay, Homer. Photograph from U.S Department of Agriculture Soil Conservation Service, August 1972.

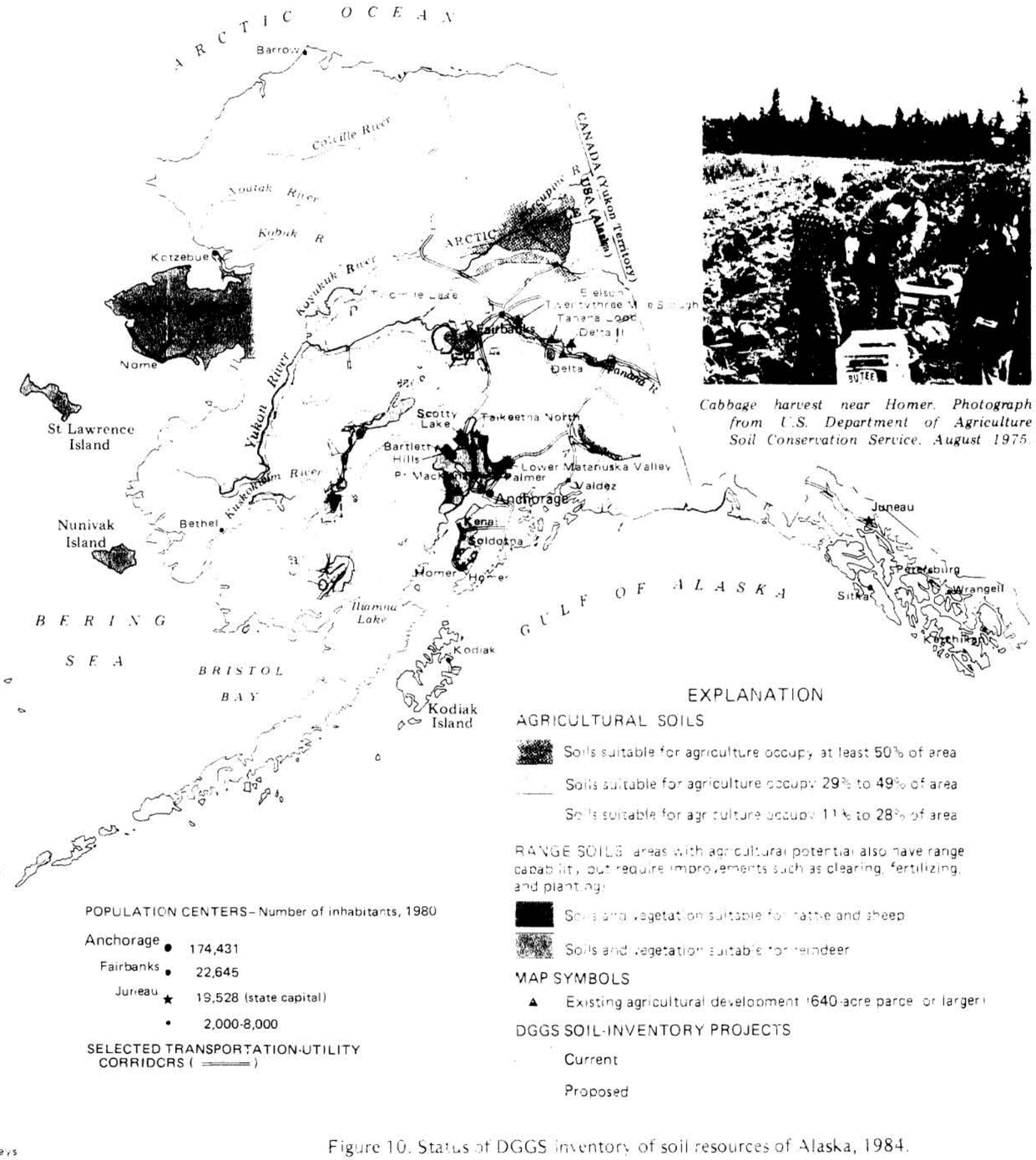
Horses in pasture in Matanuska Valley, Palmer. Photograph from U.S. Department of Agriculture Soil Conservation Service, August 1973.

Vegetable and feed crops, acres harvested in Alaska, 1965-83 (modified from Alaska Crop and Livestock Reporting Service, 1984; U.S. Dept of Agriculture, 1982, 1983).



Agricultural production in Alaska, 1975-83 (modified from Alaska Crop and Livestock Reporting Services, 1981, 1984).

Reindeer on tundra soils near Nome. Photograph from U.S. Department of Agriculture Soil Conservation Service, September 1980.



Cabbage harvest near Homer. Photograph from U.S. Department of Agriculture Soil Conservation Service, August 1975.

Figure 10. Status of DGGS inventory of soil resources of Alaska, 1984.

TIMBER RESOURCES

THE ISSUES

Sixteen percent of the forest land in the United States is located in Alaska. Accessibility, transportation, proximity to markets, and large tree size are factors that contribute to forest development in the coastal and southeastern regions of the state.

Timber harvests in Alaska are generally divided into commercial- and private-use categories. In terms of volume, commercial harvests are most common in southeast Alaska, and private use of wood fiber (for house logs and firewood) is more common in the south-central and interior regions of the state.

Recent legislation established state forests in both the Haines area and the Tanana River valley, and a third forest may soon be designated in the Cape Yakataga area along the Gulf of Alaska. Other areas under consideration as state forests are located in the Copper River basin, the Yukon-Kuskokwim River valleys, and on the Kenai Peninsula.

PROGRAM OBJECTIVES

- To collect forest-resource data.

- To evaluate timber volume, quality, productivity, and economic value for use in making forest-management decisions.

CURRENT PROJECTS

Mapping of forest resources (M.J. Wibbenmeyer, project manager) is proceeding in many areas of Alaska, including:

- Tanana State Forest: Cooperative mapping of forest resources with the U.S. Department of Agriculture Forest Service; state-forest inventory began in 1984.

- Copper River basin: Timber resources in selected areas of the Gulkana, Nabesna, McCarthy, and Valdez Quadrangles are being evaluated, and reconnaissance-level mapping of timber size and volume (1:63,360 scale) is in progress.

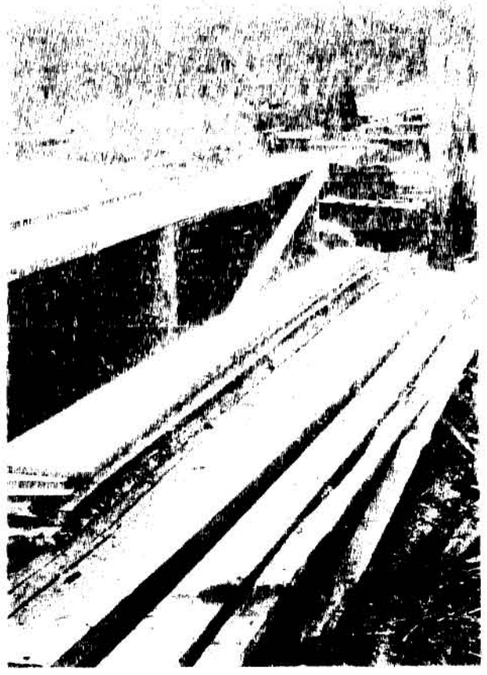
- Yakataga State Forest: Inventory and mapping of timber volume and species at 1:15,840 scale.

- Haines State Forest: Inventory and mapping of timber volume and species.

FUTURE PROJECTS

Forest resources will be assessed in the Matanuska Valley, the Susitna River valley, the Kenai Peninsula, northwest Alaska, and the Yukon and Kuskokwim River valleys.

Northland Wood logs a shelterwood unit on the Willow Island timber sale near Fairbanks. Photograph from U.S. Forest Service, 1983.



Noncommercial

Federal and private

Scale 1:12 000 000

100 0 100 200 300 400 mi

100 0 100 200 300 400 500 km

POPULATION CENTERS - Number of inhabitants, 1980

Anchorage • 174,431

Fairbanks • 22,645

Juneau ★ 19,528 (state capital)

• 2,000-8,000

SELECTED TRANSPORTATION-UTILITY CORRIDORS (═══)

Islands south of Alaska peninsula. Note Sea Otte[illegible]
from U.S. Forest Service, 1981

ARCHAEOLOGICAL RESOURCES

THE ISSUES

Alaska's prehistory began with the migration of people to the Americas via the Bering Land Bridge, which was flooded by melting of Pleistocene glaciers about 14,000 years ago. Many archaeologists maintain that emigration from Siberia began even earlier, perhaps more than 30,000 years ago. Archaeologists delineate lines of cultural development in Alaska as 'traditions.' The simplified diagram of 'Prehistoric Alaskan cultural relationships' illustrates the major cultural traditions of Alaska.

Russian explorers first entered Alaska in 1741 at Kayak Island. The European cultural tradition in Alaska is subdivided by transfer of administration from Russia to the United States in 1867. Underlying Euroamerican history is the continuation of aboriginal traditions that were modified by Euroamerican influences. Studies of recent native history are an important means of developing knowledge of prehistory through ethnographic analogy; they are also critical to a full appreciation of the importance of native viewpoints in modern society.

Archaeological and historical sites are extremely fragile and may be destroyed by construction or other development, by natural processes such as shore erosion and flooding, or by vandalism and looting. While some complete and beautiful archaeological specimens have intrinsic interest and retail value as curiosities, their greater value lies in the story they reveal about the people who occupied Alaska. This prehistory is unraveled through analysis of the horizontal spatial relationships between artifacts and their stratigraphic location at a site.

PROGRAM OBJECTIVES

- To survey, inventory, and assess archaeological and historical sites in Alaska.

- To assess the cultural significance of areas as part of the general resource-inventory program.

- To increase basic knowledge of the cultural chronology and lifeways of our forebearers.

- To maintain the Alaska Heritage Resources Survey (AHRS) files, which facilitate research on cultural resources and answer industry's need to identify its obligations for preserving cultural properties impacted by development.

CURRENT PROJECTS

Field surveys, excavations, and updating of site files have been completed for the following projects:

- Southwest archaeology: Fieldwork at Shuyak Island, intersection of Nuyakuk and Tikchik Lakes, and Walrus Islands (R.D. Shaw, project manager).

- South-central archaeology: Excavation at Nilnunqa site (mouth of Moose and Kenai Rivers) and surveys of additional areas on the Kenai Peninsula, at Tazlina Lake, and in the Matanuska Valley-Susitna River valley area (D.R. Reger, project manager).

- Preconstruction cultural-resource surveys: Excavations were completed at Rika's Landing Historic Site (Big Delta), and additional excavations associated with expansion of the Sterling Highway on the Kenai Peninsula are in progress. Preconstruction surveys were completed for various Department of Transportation and Public Facilities projects, including Quartz Lake Recreation Site Access Road, Ninilchik State Recreation Area, Sterling Highway (Mile 82.1 to 94), Aleknagik Dock Facility, new Chenega Village site, Eagle Village to Dog Island Road, Koyuk Airport improvements, Napakiak Dump Road, Nunapitchuk Airport Expansion, Murphy Dome Road, Steese Highway Alignment, Richardson Highway (Mile 129 to 185), Glenn Junction to Paxson, Kotzebue Third Avenue project, and Emmonak Airport and Material Source (C.E. Holmes, project manager).

- During the 1984 field season, DGGS conducted a field school at the Nilnunqa site in cooperation with the University of Alaska and Anchorage Community College.

- Nine thousand entries are now in the Alaska Heritage Resources Survey files, and updates and new entries total about 1,500 per year (D.R. Reger, project manager).

FUTURE PROJECTS

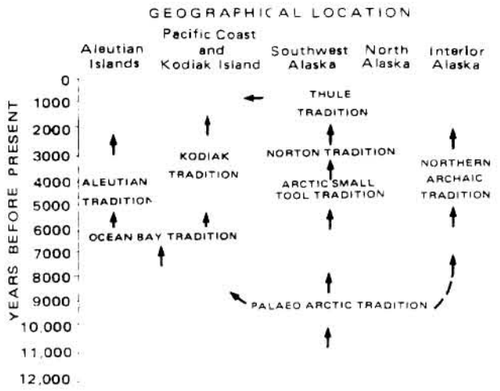
Future projects that are tentatively scheduled include:

- Field work in the Ahtna region and Shuyak Island, Wood-Tikchik State Park, northern Bristol Bay, and Yukon-Kuskokwim areas.

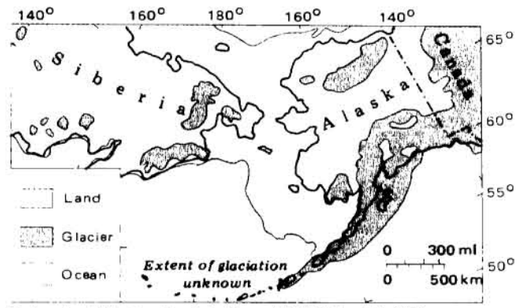
- Surveys of tideland areas in southeast Alaska are scheduled for 1987.

- Preconstruction site-assessment work required by other state agencies.

- Maintenance, updating, and computerization of the AHRS files.



***Prehistoric Alaskan** cultural relationships (modified from Dumond, 1977).*



Extent of Bering land bridge, 80,000 to 12,000 years ago. Paleoindians migrated from Siberia across this temporary intercontinental connection, initially colonized Alaska, and gradually spread throughout the Western Hemisphere (modified from Hopkins, 1967).

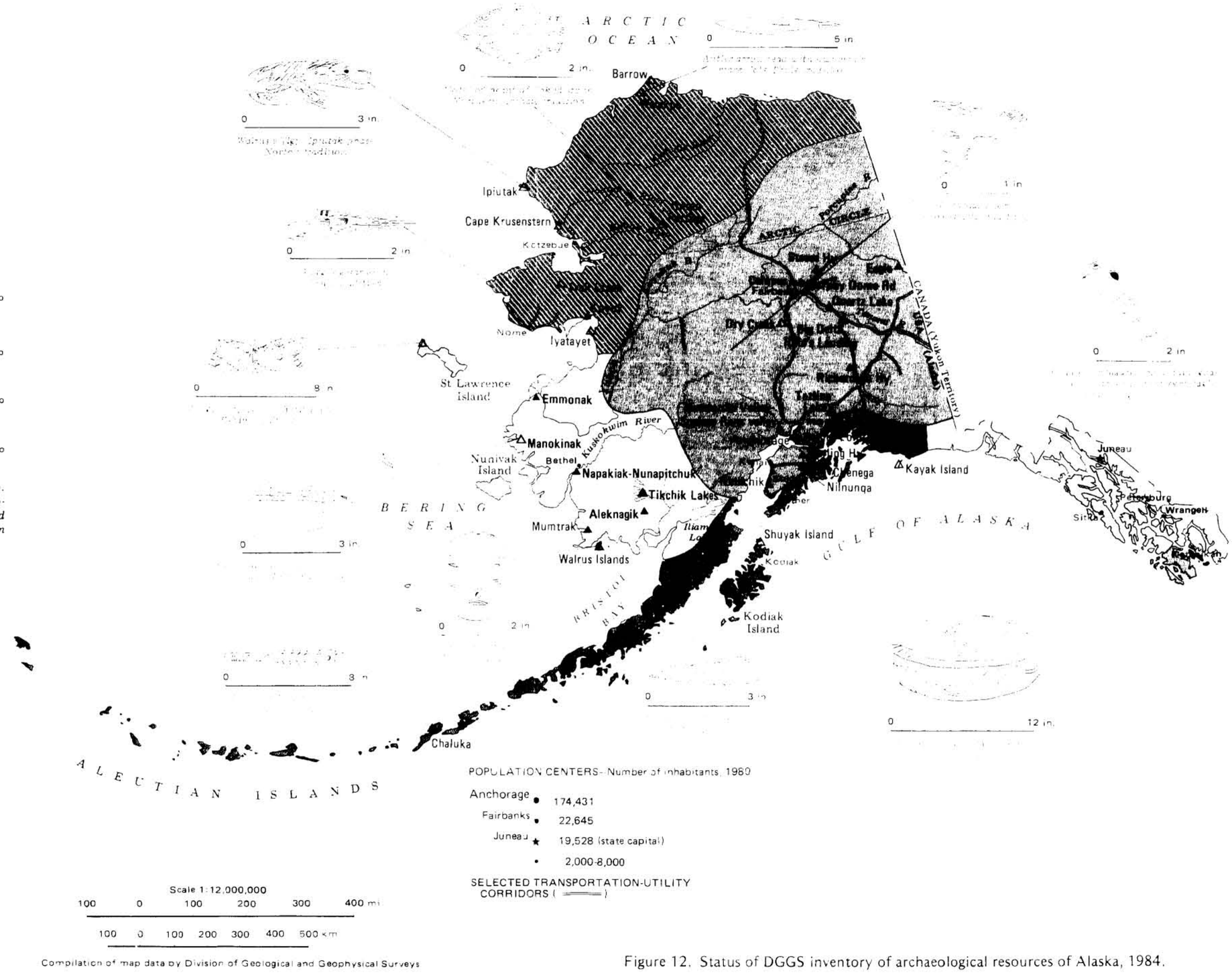


Figure 12. Status of DGGS inventory of archaeological resources of Alaska, 1984.

ENGINEERING-GEOLOGY STUDIES

THE ISSUES

Because of its size, northern location, and complex topography, Alaska is subject to more geologic constraints than any other state. Earthquakes, snow avalanches, floods, and volcanoes frequently affect the lives, property, and activities of Alaska's citizens. The powerful Great Alaska Earthquake, which struck on Good Friday in 1964 and measured 9.2 on the Richter scale, killed 131 persons and caused $311 million in property damage. Seismic sea waves generated by an earthquake (Richter magnitude 7.4) near Unimak Island on April Fool's Day in 1946 killed five Navy personnel and destroyed a lighthouse on the island; it subsequently struck the Hawaiian Islands, where 159 people were killed and 163 injured, and about $25 million in property was damaged. Snow avalanches, which are a frequent occurrence in about 30 percent of Alaska, killed 23 mountaineers and skiers between 1970 and 1979. Since 1700, at least 41 different volcanoes have erupted in Alaska, some more than 25 times, and historic ash eruptions have covered Sitka, Kodiak, and Anchorage.

Other, less spectacular processes and conditions have caused equally expensive property damage. Most of Alaska is underlain by perennially frozen ground, or permafrost, which, when disturbed and thawed, causes long-term property damage and disruption of activities. The presence of permafrost along the route of the Trans-Alaska Pipeline System (TAPS) is estimated to have added about $800 million to the construction costs of the warm-oil pipeline. The control of seasonal stream and slope icings along Alaska's highways costs over $500,000 each year.

This large frame house (near Fairbanks) was severely deformed by differential settling due to thawing of ice-rich permafrost beneath the foundation. Photograph by R.D. Reger, 1981.

Because Alaska's population is small and most of the state is undeveloped, the impact of dangerous and damaging geologic processes has been minimal. However, Alaska's population is rapidly increasing, and development is now occurring in areas exposed to geologic constraints. To protect the lives and properties of Alaskans and to plan effectively the wise use of our natural resources, Alaskans must be informed of the location, frequency, and magnitude of geologic constraints.

PROGRAM OBJECTIVES

- To identify geologic constraints, define areas where natural processes and conditions may be destructive to life and property, and recommend avenues of mitigation.

- To monitor geologic events, such as earthquakes, landslides, and avalanches, so that future construction and planning incorporate knowledge of past events.

- To provide basic data for the proper design of public facilities, including buildings, roads, airports, ports, bridges, and energy-related structures and corridors.

CURRENT PROJECTS

Several geologic events were recently evaluated, including:

- Mt. Veniaminoff eruption
- Richter magnitude 6.5 earthquake near Valdez (July 1983)
- Landslides near Wrangell
- Seismic hazards in Fairbanks
- Snow avalanches along the Richardson Highway
- Pillar Mountain landslide near Kodiak.

Seismic-engineering projects (J.N. Davies, project manager) include:

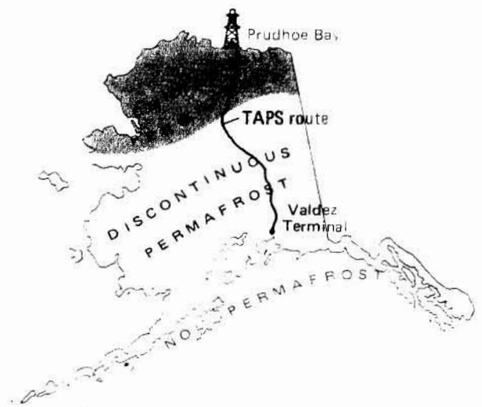
- Establishment and maintenance of stations in the Cook Inlet-Kodiak Island and interior Alaska seismic networks and in the Cook Inlet volcano-observatory network.
- Establishment of strong-motion accelerographs, which measure the effects of earthquakes on large buildings, in cooperation with the Municipality of Anchorage.
- Establishment of the Alaskan Seismic Data Center in Fairbanks, where data from all earthquake-monitoring projects in Alaska are collected.

Engineering-geology studies (R.G. Updike, project manager) include:

- Detailed, three-dimensional geologic mapping of the Anchorage area.
- Evaluation of the engineering properties of foundation soils in the Anchorage area.
- Technical assistance for several construction projects, including the Port of Anchorage expansion, the Anchorage state office building, the Eklutna water-supply pipeline, the Susitna hydroelectric project, and the Seward port expansion.

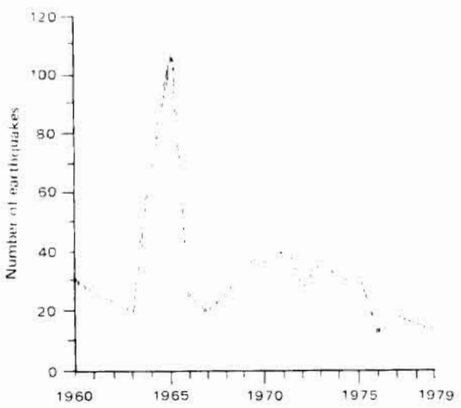
FUTURE PROJECTS

- DGGS will continue to provide engineering-geology advice to state, federal, and local agencies and to the private sector, and will directly assist other state agencies in the planning and design of major construction projects.
- Studies are planned for critical areas of high population growth and significant geologic constraints. Anchorage area studies will near completion by 1986, and subsequent studies will begin in the Seward, Kodiak, and Valdez areas.
- Maintenance of seismic-monitoring, strong-motion accelerograph, and volcano-observatory networks will continue, and additional seismic stations will be established in southeastern and southwestern Alaska.
- Other engineering-geology studies will focus along the Border Ranges and Castle Mountain faults in south-central Alaska and in marine port areas.



About 82 percent of Alaska is underlain by permafrost (modified from Pewe, 1982).

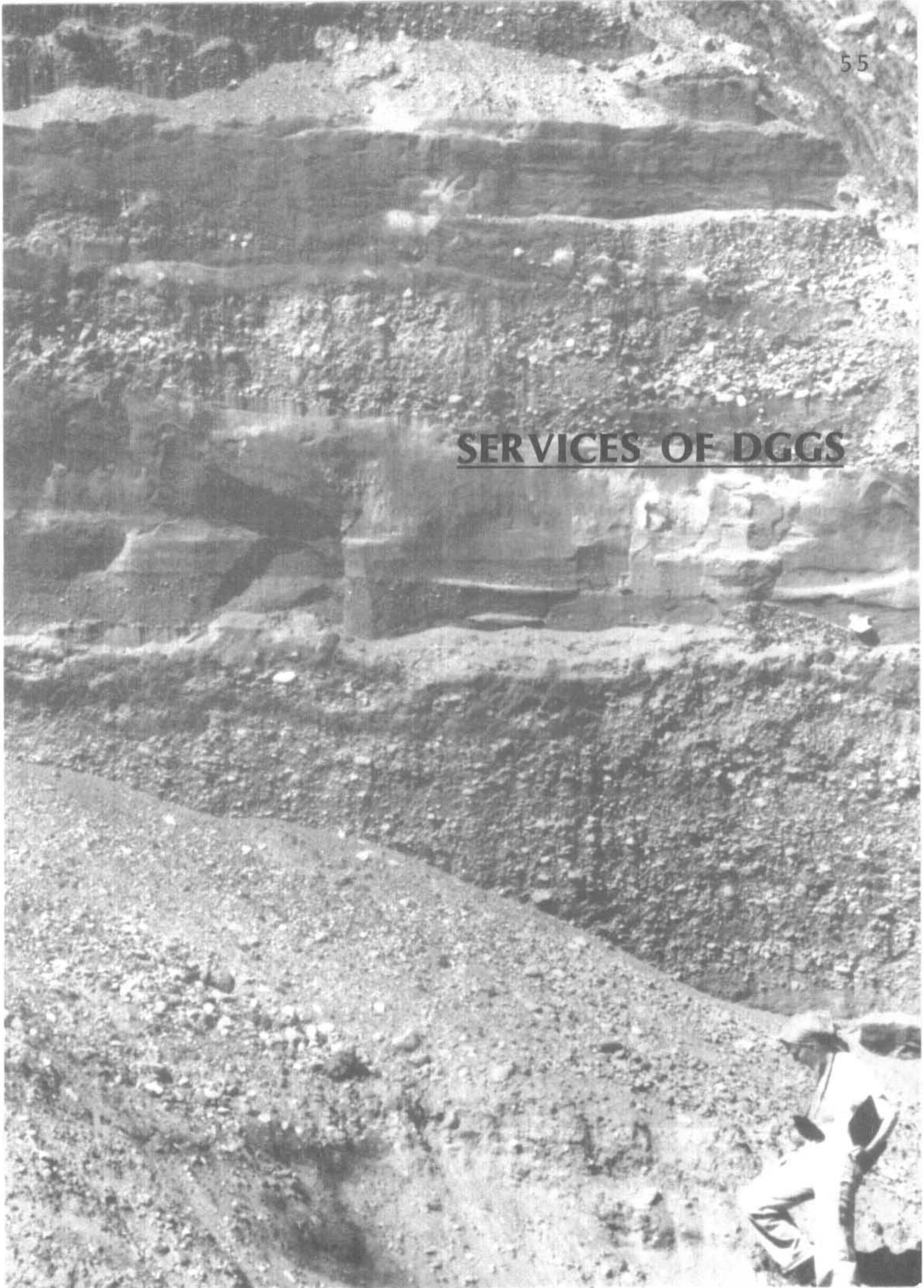
Destruction of Government Hill School in Anchorage by 1964 Prince William Sound Earthquake. Photograph from NOAA-EDIS files.



Frequency of potentially damaging earthquakes (Richter magnitude 5.5 or greater) in Alaska, 1960-79.

Van destroyed by air blast from powder-snow avalanche, Chugach State Park. Photograph by G.D. March, 1980.

Figure 13. Status of DGGS engineering-geology studies of Alaska, 1984.

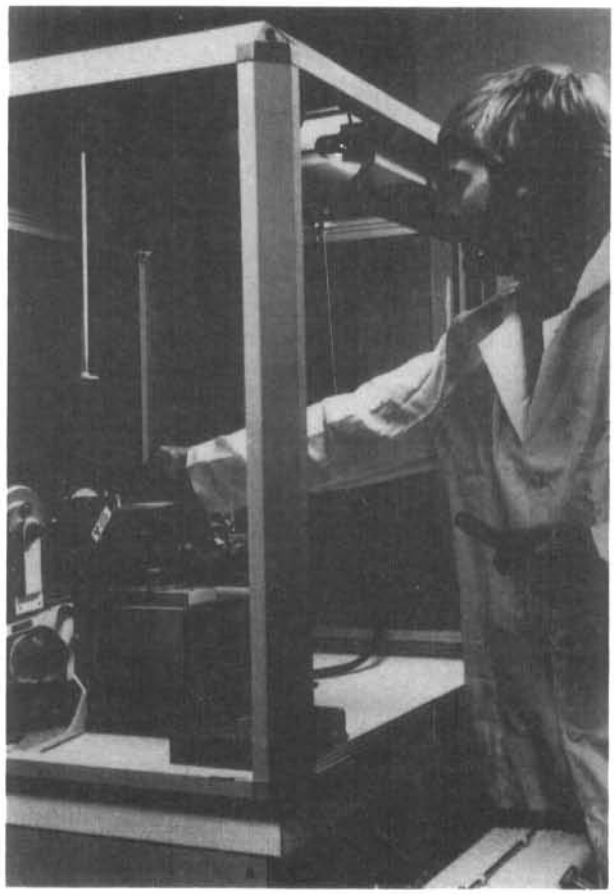


SERVICES OF DGGS

SERVICES OF DGGS

INTRODUCTION

Alaska Statute 27.05 requires the Department of Natural Resources to "make assays and analyses of Alaskan ores and minerals...., (to) conduct a continuing survey of the mineral resources and mining operations of the state, and (to) disseminate information regarding them to assist prospectors and miners." Many individuals and organizations use information provided by DGGS. Officials of the state and federal governments, business interests, and nonprofit advisory groups need objective resource information for management recommendations and decisions. Residents of Alaska need information on resources and on geologic constraints such as permafrost, floods, and earthquakes so that they can utilize their land wisely. Recreationists need information on subjects such as rivers, vegetation, geology, and archaeology to make their outdoor experiences more meaningful. In 1983, over 6,500 people visited our offices to obtain information on a host of interests.



DGGS Public Assay Laboratory staff provide analyses of rock, mineral, and ore samples for both the public and for DGGS geologists. Photograph by B.A. Kelly, 1983.

The Survey staff of approximately 150 people consists of many resource experts and support personnel who are uniquely qualified by their extensive education, training, and technical experience in numerous subject areas, including hydrology, forestry, geology, soils, coal, peat, geothermal energy, archaeology, operations research, and systems analysis.

PUBLIC ASSAY LABORATORY

The Survey maintains and operates a Public Assay Laboratory, which is available to members of the public who want to locate and develop Alaska's mineral resources. The laboratory staff provides advice and information on mineral-related subjects of personal interest. The laboratory is equipped with modern instrumentation for the analysis of rocks, minerals, ores, and sediments. Located in Fairbanks, the laboratory routinely provides trace-element analyses of samples, scientific identification of rocks and minerals, major-oxide analyses of rocks, and assays for gold, silver, and platinum. As mandated in AS 27.05, there is no direct charge to participating members of the public for these services.

STORAGE OF NATURAL-RESOURCE DATA

DGGS data-storage and retrieval systems are designed to preserve valuable data and allow users ready access to accurate, objective resource information. Although much of this information is maintained in the traditional file format, an increasing amount is stored in computer memory. Mineral, archaeological, and other samples and specimens are also preserved for future analysis.

Examples of some of these information resources include:

- Geophysical data.
- Hydrologic data, some of which are shared with the natural water-data storage and retrieval system (WATSTORE), which is operated by the U.S. Geological Survey.
- Archaeological and historical data, stored in the Alaska Heritage Resources Survey (AHRS) files.

•Rock and core samples from water wells, oil-and-gas wells, and mineral exploration, stored in the DGGS-managed Alaska Materials Center in Eagle River.

•Computer storage of interpretative analyses of resource data in map and other geophysical formats.

•Analyses of 63,000 stream- and lake-sediment samples collected from 103 quadrangles (1:250,000-scale), stored in the Geochemical Data Modeling system.

PUBLICATIONS

The staff prepares and publishes many reports. All are available to the public. Many are free, and others may be purchased for a minimal price. Publications sales and distribution offices are located in Fairbanks, Anchorage, Juneau, and Ketchikan. Categories of DGGS reports include:

The results of DGGS research are published in a variety of formats that are readily available to the public. During FY-84, DGGS distributed more than 60,000 documents to users in all 50 states and more than 15 foreign countries. Photograph by B.A. Kelly, 1984.

Professional Reports communicate new information in the form of maps and text and are the final product of original research. 'Short Notes on Alaskan Geology,' an annual Professional Report, consists of recent research papers that are too brief to publish as separate Professional Reports.

Special Reports are summaries of current or expected resource problems of statewide significance. Bibliographies are published as Special Reports, as are maps that summarize information on resources such as oil and gas, coal, and geothermal energy. 'Alaska's Mineral Industry,' an annual review of Alaskan mineral production, is also published as a Special Report.

Reports of Investigations, often in map format, provide for rapid release of DGGS research and invite feedback from readers concerning errors of logic or fact.

Guidebooks provide general and technical information along specific routes in Alaska, for example, the Dalton Highway.

Information Circulars are free pamphlets on popular subjects such as proper claim staking, amateur gold prospecting, and drilling a water well. Information Circular 11 includes a list of all DGGS publications.

'Alaska Mines & Geology', the DGGS quarterly newsletter, recapitulates recent resource activities in the 49th State and includes metals-market quotations and DGGS publications announcements. The newsletter distribution includes readers in all 50 states and more than 15 foreign countries.

RESOURCE ANALYSIS

Recent advances in scientific computers have greatly expanded our ability to analyze, synthesize, integrate, and evaluate surface and subsurface resource data. Policymakers, decision-makers, planners, and resource analysts use computer-based analytical procedures for the assessment and evaluation of natural-resource data. These procedures allow the integration of complex natural-resource data in geographically referenced digital data bases. Resource analysis supports the appraisal and inventory activities in DGGS by providing:

• Digital compilation of vegetation, soils, geology, and hydrology data to produce maps of both single- and multiple-data sets.

• Geoprocessing of several resource-data sets (for example, vegetation, soils, and surficial geology) to produce integrated terrain-unit maps.

• Probabilistic resource appraisals of both undiscovered oil and gas in selected basins and mineral deposits in selected terranes.

- Geochemical and mineral analyses.
- Hydrological analyses.

DGGS maintains programming and computer facilities to analyze natural-resource data. In Anchorage, a Data General MV-8000 Computer is used to interpret and process proprietary geophysical and geological data for Alaska's oil-and-gas lease-sale program. A second Data General MV-8000 computer is used to process hydrologic, geologic, and other basic natural-resource data for more general use.

A specially designed data-modeling system programmed on a Data General S250 computer in Fairbanks allows DGGS to analyze a variety of geological, geochemical, and geophysical data in support of natural-resource appraisals and evaluations. Data and derivative maps are available to both the public and private sectors.

DGGS provides analytical expertise and scientific-programming assistance to the Department of Natural Resources and to other state and federal agencies. Resource analysts are available to answer specific information requests and to assist in developing new data bases and analytical techniques. For example, the Alaska Resource Management Mapping Program (fig. 14) is designed to compile interpretive resource information at various map scales and resolutions. This cooperative effort involves federal, state, and local governments. To date, compilations of resource data are planned for approximately half of Alaska. Under this program, maps showing available information on vegetation, soil distribution, surficial geology, land use, mineral occurrences, and known mining claims are digitized and will be available in tape format for geoprocessing and analysis.

DGGS geophysicist uses computer-assisted plotter to outline base map for use in Alaska's oil-and-gas lease-sale program. Photograph from D.M. McGee, 1984.

Resource analysts are available to answer specific information requests and to assist in developing new data bases and analytical techniques. Photograph by M.S. Christy, 1983.

DGGS RESOURCE-MANAGEMENT MAPPING PROGRAM

Products	Services
Low-resolution digitally and manually derived data bases (1:250,000 scale)	STATEWIDE PROGRAMS • Statewide plan • Land selection or relinquishment
	REGIONAL PROGRAMS • Area plans • Fire-suppression plans
High resolution digitally and manually derived data bases (1:63,360 scale or larger)	MANAGEMENT PROGRAMS • Park master plans • District-management plans • Land disposal plans
Type of support	DEVELOPMENT PROGRAMS • Timber sales • Agricultural-development programs
Primary	
Secondary	

The goal of the Resource Management Mapping Program is to compile and digitize basic natural-resource data into map formats that are designed to facilitate land-management decisions in the Department of Natural Resources. Under the current program, as demonstrated by the Copper River project, low-resolution data at 1:250,000 scale or lower is augmented with high-resolution data (1:63,360 scale or higher) for high-interest areas. The results include both manually and computer-generated products for each data set. Data sets are also combined to produce terrain-unit maps that depict combinations of geology, vegetation, and soils information.

Geochemical data modeling is a computer assisted method of reducing thousands of rock and sediment trace-element analyses to summary maps and reports that show the location and extent of mineralized lands. Methods used by DGGS integrate geochemistry, geology, geophysics, and remote-sensing data to obtain the most valid assessment with available information.

Data on streamflow, water quality, and ground water are on digital computer tapes. Mathematical models of hydrologic systems that utilize these data are prepared to analyze the affects of increased water usage on given hydrologic systems.

Although geochemical-data and hydrologic modeling projects are not shown on this map, they are important elements of the resource-appraisal program.

Figure 14. Status of DGGS resource-analysis studies of Alaska, 1984.

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W.W. Barnwell, Deputy State Geologist

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R.W. Ireland, Hydrologist
S.F. Mark, Hydrologist
M.A. Maurer, Hydrologist
G.V. McCoy, Hydrologist
M.A. Moorman, Geologist
J.A. Munter, Hydrologist

[1] In addition to the permanent staff listed above, DGGS has employed over 100 students in the Department of Natural Resources Student Intern Program.
[2] Section or Unit Chief
[3] Acting Section Chief

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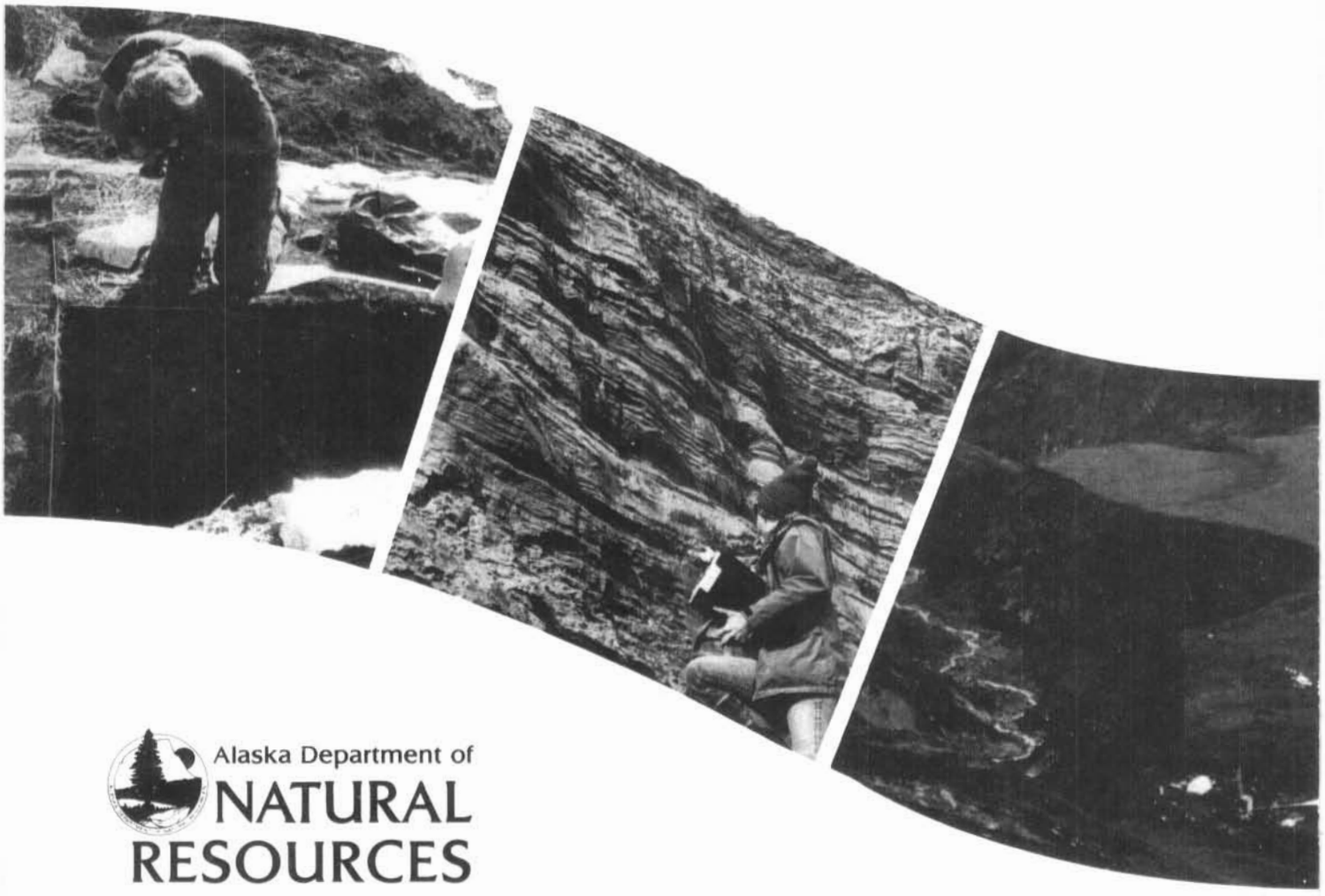

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