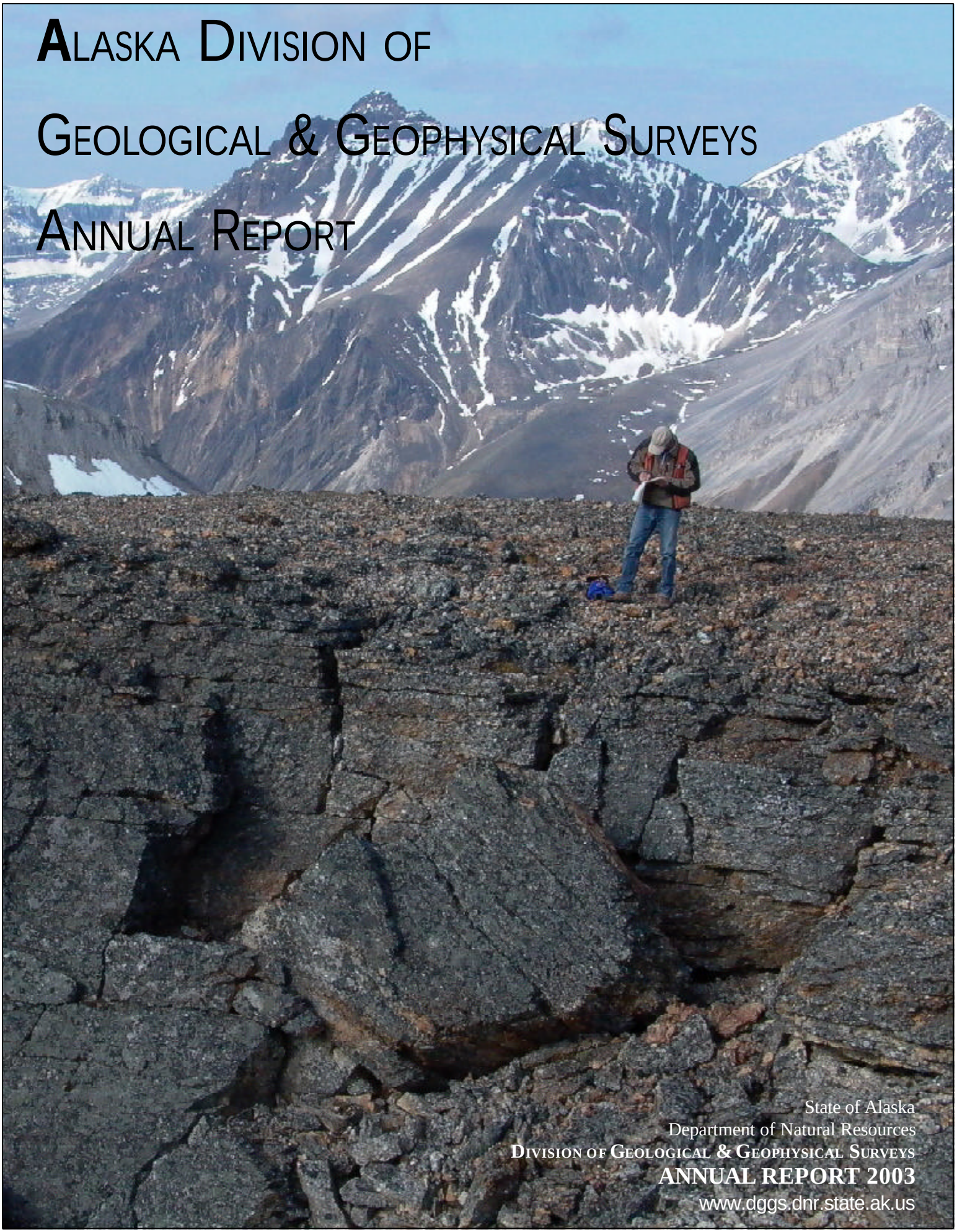
Alaska Division of Geological & Geophysical Surveys Annual Report



State of Alaska
Department of Natural Resources
Division of Geological & Geophysical Surveys
ANNUAL REPORT 2003
www.dggs.dnr.state.ak.us

Sec. 41.08.015. State geologist. The commissioner shall appoint the state geologist, who must be qualified by education and experience to direct the activities of the division. (§ I ch 93 SLA 1972)

Sec. 41.08.017. Hydrological and seismic hazard data declared to be of public interest.

(a) Systematic collection, recording, evaluation, and distribution of data on the quantity, location, and quality of water of the state in the ground, on the surface of the ground, or along the coasts, are in the public interest and necessary to the orderly domestic and industrial development of the state.

(b) Systematic collection, evaluation, archival, and distribution of geologic data and information on earthquakes, volcanic eruptions, and engineering geology and identification of potential seismic, volcanic, and other geological hazards throughout the state are in the public interest and necessary to orderly, safely, and cost-effective development in the state. (§ 1 ch 41 SLA 1977; am § I ch 101 SLA 1983; am § 3 ch 36 (sic) SLA 1987)

Sec. 41.08.020. Powers and duties. (a) The state geologist shall conduct geological and geophysical surveys to determine the potential of Alaskan land for production of metals, minerals, fuels, and geothermal resources; the locations and supplies of groundwater and construction materials; the potential geologic hazards to buildings, roads, bridges, and other installations and structures; and shall conduct such other surveys and investigations as will advance knowledge of the geology of the state. With the approval of the commissioner, the state geologist may acquire, by gift or purchase, geological and geophysical reports, surveys, and similar information.

(b) In addition, the division of geological and geophysical surveys shall:

(1) collect, record, evaluate, and distribute data on the quantity, quality, and location of underground, surface, and coastal water of the state;

(2) publish or have published data on the water of the state;

(3) require the filing with it of the results and findings of surveys of water quality, quantity, and location;

(4) require of water well contractors, the filing with it of basic water and aquifer data normally obtained, including but not limited to well location, estimated elevation, well driller's logs, pumping tests and flow measurements, and water quality determinations;

(5) accept and spend funds for the purposes of this section, AS 41.08.017, and 41.08.035 and enter into agreements with individuals, public or private agencies, communities, private industry, state agencies, and agencies of the federal government;

(6) collect, evaluate, and distribute geologic data on seismic events and engineering geology of the state;

(7) identify potential seismic hazards that might affect development in the state;

(8) inform public officials and industry about potential seismic hazards that might affect development in the state.

(§ 1 ch 93 SLA 1972; am § 2 ch 41 SLA 1977; am § 7 ch 175 SLA 1980; am § 2 ch 101 SLA 1983; am § 4 ch 36 SLA 1987)

FRONT COVER: *Former Division of Geological & Geophysical Surveys geologist David LePain takes notes atop an outcrop of Devonian-age Kanayut Conglomerate in this view to the southwest up Kayak Creek valley, 20 miles east–northeast of Anaktuvuk Pass in the north-central Brooks Range. These rocks structurally overlie younger rocks of the light gray, Mississippian-age Lisburne Limestone exposed in the distance behind him to the right, emplaced there by thrust faulting during Cretaceous time. This field work is part of the National Cooperative Geologic Mapping Program, partially supported by federal funds through the U.S. Geological Survey's STATEMAP program. Deciphering the depositional environments of these rocks and understanding the mountain-building structures in the Brooks Range are important for supporting oil and gas exploration in the southern North Slope region and Colville basin. Rocks of the Kanayut Conglomerate are buried about 8,000 feet beneath the surface at Prudhoe Bay. Photo by Rocky R. Reifenstuhl.*

ALASKA DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS ANNUAL REPORT

State of Alaska
Department of Natural Resources
DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS
ANNUAL REPORT 2003

State of Alaska
Frank H. Murkowski, Governor

Department of Natural Resources
Tom Irwin, Commissioner

Division of Geological & Geophysical Surveys
Rod Combellick, Acting Director

DGGS publications may be inspected at the following locations. Address mail orders to the Fairbanks office.

- Division of Geological & Geophysical Surveys
  ATTN: Geologic Communications
  3354 College Rd.
  Fairbanks, Alaska 99709-3707

- University of Alaska Anchorage Library
  3211 Providence Drive
  Anchorage, Alaska 99508

- Alaska Resource Library
  and Information Services
  3150 C Street, Suite 100
  Anchorage, Alaska 99503

- Elmer E. Rasmuson Library
  University of Alaska Fairbanks
  Fairbanks, Alaska 99775-1005

- Alaska State Library
  State Office Building, 8th Floor
  333 Willoughby Avenue
  Juneau, Alaska 99811-0571

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NOTE: Mention of any company or brand name does not constitute endorsement by any branch or employee of the State of Alaska.

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FOREWORD

2003 was a year of many challenges, accomplishments, and opportunities for the Division of Geological & Geophysical Surveys (DGGS). The year began with the retirement of former Director and State Geologist Milton Wiltse and the resignation of North Slope geology program manager David LePain to accept a position with the Wisconsin Geological and Natural History Survey. The latter departure left our Energy section short-staffed at a time when the new administration under Governor Frank Murkowski is clearly placing a high priority on accelerated oil and gas development to help improve the state's economic outlook. With some internal restructuring and much hard work, the Energy section met the challenge by completing field work in two areas of the Brooks Range foothills region of the North Slope, including a 3-day geology tour for industry representatives, and collecting field data on shallow gas potential in several areas of the state. The Energy section was also successful in receiving federal funding for several upcoming geological projects in rural energy and commercial oil and gas. A major Department of Energy-funded project will be conducted jointly with the Division of Oil & Gas to evaluate the reservoir potential of rocks in the Bristol Bay and Alaska Peninsula areas. We are pleased to report that after a lengthy recruitment process we have filled the vacant energy geologist position. Marwan Wartes, who is finishing his PhD dissertation at the University of Wisconsin Madison, will start June 1, 2004, in time to participate in the North Slope field work. We figured Wisconsin owed us one, and are pleased that Marwan will be joining us.

The Minerals section published a preliminary geologic map of the Salcha River–Pogo area and conducted field work in the Livengood area as part of the USGS Statemap program, which provides matching federal funds for geologic mapping. This section also completed and published airborne-geophysical surveys in three areas: Council, Sleetmute, and Delta River. Release of the BLM-funded Delta River survey brought immediate results in extensive staking of the area by mining companies.

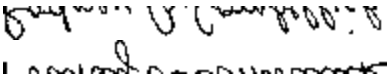
The magnitude 7.9 Denali fault earthquake of November, 2002, presented significant and important opportunities for improving our knowledge of active faulting and earthquake effects in Alaska. During summer of 2003, DGGS's Engineering Geology section played a key role in extensive field studies with the U.S. Geological Survey, University of Alaska Fairbanks, and other organizations to measure offsets and map the surface ruptures of the Denali fault, Totschunda fault, and the newly discovered Susitna Glacier fault, all of which ruptured during this event. This information will help determine how much strain was released on the Denali fault system, which is important for estimating its future earthquake potential and the likelihood of rupture of adjacent sections, such as the one crossing the Parks Highway corridor near Cantwell. Engineering Geology section was also successful in receiving DGGS's first-ever grant from the National Science Foundation for a 3-year cooperative geoscience outreach project with the University of Alaska Fairbanks and University of Wisconsin Madison. The project will develop a hands-on curriculum for middle- and high-school students in rural Alaska to learn about modern techniques for locating and describing geological features and landforms in their areas.

DGGS's role as a participating agency in the Alaska Volcano Observatory (AVO) was key to AVO's expansion of volcano monitoring to the far western Aleutian Islands and the development of a comprehensive, interactive geologic database of information on volcanoes in Alaska (GeoDIVA). DGGS coordinated the ship and helicopter logistics for installing new seismic networks on Gareloi and Tanaga volcanoes, designed and implemented GeoDIVA, and continues to manage the popular AVO external and internal Web sites.

DGGS's Geologic Materials Center (GMC) in Eagle River received several important collections from industry in 2003, which are now available to the public. Notable among these are BP's Badami Field oil and gas rock collection as well as samples from another 10 BP exploratory wells in northern Alaska, Union Oil Company's collection of Amoco oil and gas well samples from Cook Inlet, and Cook Inlet Region, Inc.'s hard-rock mineral core and oil and gas well samples, among others. The GMC is literally bursting at the seams and we are looking at options for upgrading or replacing the facility in the near future.

Perhaps the greatest challenge for DGGS in 2003 was the complete move of our Fairbanks offices to a new location. The staff came through as they always do in a challenge, pitching in where needed and giving much extra effort to accomplish the move with very little disruption to the Division's work. Please come visit us in our new offices at 3354 College Road. The project summaries in this annual report provide a good synopsis of the excellent work that the people of DGGS are doing, but we invite you to come see for yourself.

Sincerely,



Rodney A. Combellick
Acting Director

Division of Geological & Geophysical Surveys
ANNUAL REPORT 2003

INTRODUCTION

MISSION STATEMENTS

DEPARTMENT OF NATURAL RESOURCES

Mission: *Develop, conserve, and enhance natural resources for present and future Alaskans*

DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

Mission: *Determine the potential of Alaskan land for production of metals, minerals, fuels, and geothermal resources, the locations and supplies of groundwater and construction material; and the potential geologic hazards to buildings, roads, bridges, and other installations and structures (AS 41.08.020)*

HISTORY

The present Division of Geological & Geophysical Surveys evolved from Alaska's Territorial Department of Mines. That heritage is reflected in the Division's ongoing commitment to the application of geology to improve the welfare of Alaska citizens. The name and mission of the Division were stabilized in 1972 with the passage of Alaska Statute AS 41.08.

Territorial Department of Mines, 1959
Division of Mines and Minerals, 1959-1966
Division of Mines and Geology, 1966-1970
Division of Geological Survey, 1970-1972
Division of Geological & Geophysical Surveys, 1972-Present

LEADERSHIP

Eight qualified professional geoscientists have served as State Geologist:

Jim Williams, 1959-1971
William Fackler, 1971-1973
Donald Hartman, 1973-1975
Ross G. Schaff, 1975-1986
Robert B. Forbes, 1987-1990
Thomas E. Smith, 1991-1995
Milton A. Wiltse, 1995-2002
Rodney A. Combellick (Acting) 2003-Present

By statute the State Geologist also serves as the Director of the Division of Geological & Geophysical Surveys within the Department of Natural Resources (DNR) and is appointed by the DNR Commissioner. Since the early 1970s, the State Geologists have been selected from lists of candidates prepared by the geological community and professional societies within Alaska—similar to the process by which judicial appointees are selected. The qualifications and responsibilities of the State Geologist and the mission of DGGS are defined by statute.

STATUTORY MANDATES

Alaska Statutes Sec. 41.08.010. Division of geological and geophysical surveys. There is established in the Department of Natural Resources a Division of geological and geophysical surveys under the direction of the state geologist. (1 ch 93 SLA 1972)

Sec. 41.08.015. State geologist. The commissioner of natural resources shall appoint the state geologist, who must be qualified by education and experience to direct the activities of the Division. (1 ch 93 SLA 1972)

Sec. 41.08.020. Powers and duties. (a) The state geologist shall conduct geological and geophysical surveys to determine the potential of Alaskan land for production of metals, minerals, fuels, and geothermal resources; the locations and supplies of groundwater and construction materials; the potential geologic hazards to buildings, roads, bridges and other installations and structures; and shall conduct such other surveys and investigations as will advance knowledge of the geology of Alaska. With the approval of the commissioner, the state geologist may acquire, by gift or purchase, geological and geophysical reports, surveys and similar information.

LOCATION

The Division's administrative headquarters and personnel were moved to Fairbanks in 1987. The close proximity of the Division to the earth science research laboratories of the University of Alaska Fairbanks campus has a strategic benefit to the DGGS program. University staff and students are important adjunct members of many DGGS project teams.

Current DGGS staff totals 32 permanent full-time professional and support personnel, two non-permanent professional geologists, a Director, and seven student interns hired through the State of Alaska internship program.

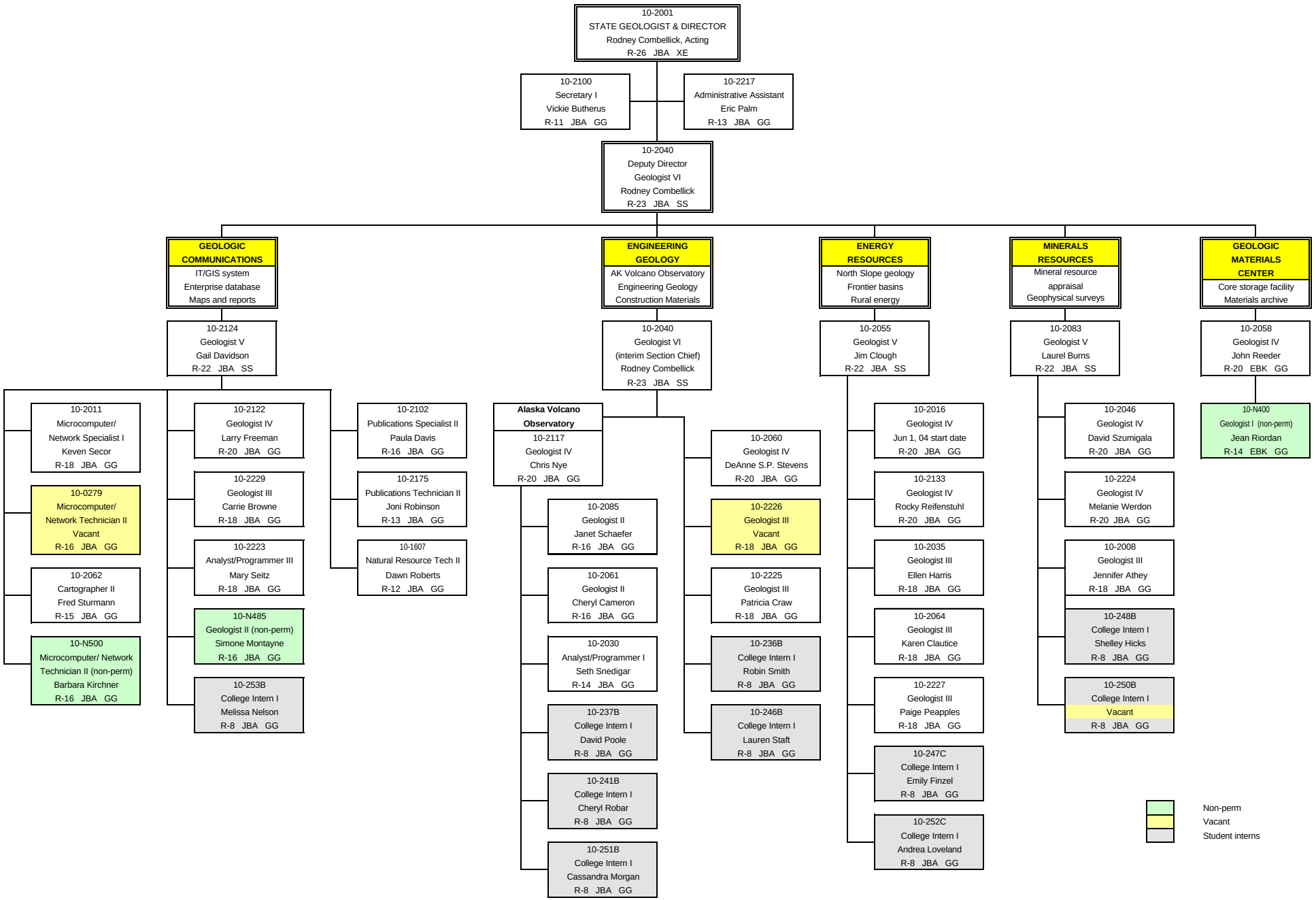
DGGS operates a Geologic Materials Center in Eagle River, Alaska, staffed by one professional geologist and one non-permanent junior geologist.

ORGANIZATION

DGGS is one of seven Divisions within the Alaska Department of Natural Resources (fig. 1).

Division of Geological & Geophysical Survey offices in Fairbanks

Geologic Materials Center in Eagle River



3/5/2004
V. Butherus

Under the overall administration of the Director's Office, The Division of Geological & Geophysical Surveys is organized into four sections and the Geologic Materials Center:

The **Director's Office** provides strategic planning for the Division's programs to ensure that DGGS is meeting the needs of the public within the guidelines of AS 41.08.020, manages the Division's fiscal affairs, and provides personnel and clerical services. The Director acts as a liaison between the Division and local, state, federal, and private agencies; seeks out and encourages cooperative geologic programs of value to the state; and advises the Commissioner of the Department of Natural Resources about geologic issues.

L to R: Rod Combellick, Eric Palm, Vickie Butherus.

The **Mineral Resources Section** collects, analyzes, and makes available information on the geologic and geophysical framework of Alaska as it pertains to the mineral resources of the state. Summary maps and reports illustrate the geology of the state's prospective mineral terranes and provide data on the location, type, and potential of the state's mineral resources. The Mineral Resources Section seeks to improve the success of mineral discovery in Alaska so that new employment opportunities are created for Alaska's citizens.

L to R: Melanie Werdon, Dave Szumigala, Laurel Burns, Shelley Hicks, Jen Athey.

The **Energy Resources Section** generates new information about the geologic framework of frontier areas that may host undiscovered oil, gas, or coal resources. Summary maps and reports illustrate the geology of the state's prospective energy basins and provide data relating to the location, type, and potential of the state's energy resources. The Energy Resources Section's scope of activities includes work that seeks to identify local sources of energy for rural Alaska villages and enterprises, and work that seeks to improve the success of state-revenue-generating commercial oil exploration and development.

L to R: Jim Clough, Karen Clautice, Paige Peapples, Ellen Harris, Rocky Reifenstuhl. Inset: Marwan Wartes.

Back L to R: Seth Snedigar, Janet Schaefer, Chris Nye, Patty Craw, De Anne Stevens. Front L to R: Lauren Staft, Cheryl Cameron, Robin Smith.

The **Engineering Geology Section** collects, analyzes, and compiles geologic data useful for engineering and hazard-mitigation purposes. Surficial-geologic maps portray the distribution of surficial geologic materials and provide information on their engineering properties and potential as construction-materials sources. Studies of major geologic hazards like earthquakes and volcanoes result in reports outlining potential impacts on susceptible areas and estimated frequencies of occurrence.

Back L to R: Gail Davidson, Joni Robinson, Kevin Secor, Larry Freeman. Middle L to R: Melissa Nelson, Carrie Browne, Bobby Kirchner, Dawn Robert, Fred Sturmann. Bottom L to R: Simone Montayne, Susan McMenamin, Paula Davis.

The **Geologic Communications Section** has the primary responsibility for transferring Division-generated geologic information to the public and for maintaining and improving public access to DGGS geologic information. Increased utilization of computer technology is resulting in faster preparation of maps and reports and a wider awareness of Alaska geologic information available at DGGS. This section is coordinating the design of a computer-hosted database for the Division's digital and map-based geologic and geophysical data. The section responds each year to an estimated 2,500 public inquiries about geologic resources in Alaska.

John Reeder

The **Geologic Materials Center** is the state's single central repository for representative geologic samples of oil- and gas-related well cores and cuttings, mineral deposit core samples, and regional geologic voucher samples. These materials are routinely used by industry to enhance the effectiveness and success of private-sector energy and mineral exploration ventures. New materials are continuously acquired. Access to the materials at the GMC is free. To ensure that the value of the GMC holdings is maintained over time, any new data generated from privately funded analyses of the geologic materials stored there must be donated to the GMC database.

RELATIONSHIPS WITH OTHER STATE AGENCIES

DGGS provides other DNR agencies with routine analyses and reviews of various geologic issues such as hazards evaluations of pending oil lease tracts; competitive coal leases; geologic assessments of land trades, selections, or relinquishments; mineral potential; and construction materials availability. DGGS' interaction with the Land Records Information Section in the DNR Support Services Division continues to increase as more of our geologic data are compiled and organized in digital format amenable to merging with other land information. The DGGS energy group works closely with geologic personnel in the Division of Oil and Gas (DOG) on issues related to rural energy sources and in providing geologic control for the subsurface oil-related geologic analyses conducted by DOG. DGGS supplies the Division of Forestry with information about the mineral resource potential within state forests. Each year DGGS prepares an annual report on the status of Alaska's mineral industry in cooperation with the Division of Community & Business Development of the Department of Community & Economic Development. DGGS works closely with Division of Emergency Services in the Department of Military and Veterans Affairs to evaluate hazards and design scenarios for hazards events.

Funding to support work requested by other DNR agencies mostly has been drawn from our yearly general fund appropriation. For larger inter-division efforts, however, the work is supported by interagency fund transfers, Capital Improvement Project (CIP) funding, federal cooperative agreements, or private industry grants that supplement DGGS's general funds. We are currently engaged in a cooperative project with the Division of Oil and Gas to characterize the sedimentary petrology and reservoir potential of oil and gas exploration targets in the North Slope foothills and will soon begin a similar cooperative project for assessment of oil and gas potential in the Bristol Bay region.

DGGS provides ongoing geologic technical services to other DNR divisions and line agencies of state government. Typically these activities occupy from 5 to 10 percent of our total effort. Over the last few years, interagency funding from other DNR divisions has been one to three percent of our total budget.

RELATIONSHIPS WITH LOCAL GOVERNMENTS

Most of the cooperative efforts implemented by DGGS with borough and municipal governments are conducted on a mutually beneficial but informal basis. For example, in FY02, DGGS participated a federally funded cooperative program to develop tsunami-inundataion maps for coastal communities. In Kodiak, the first community for which maps were prepared, the City and Borough governments worked closely with DGGS and other project cooperators to help design the project outputs to best benefit their needs for planning evacuation areas and routes. Similar cooperative efforts are currently underway or will soon be initiated with the Kenai Peninsula Borough and the cities of Homer, Seldovia, and Seward for the next tsunami-inundation maps to be generated by this program. The Engineering Geology section has also worked closely with the Municipality of Anchorage in the development of earthquake site-response maps for the Anchorage area, and the Energy section is working closely with the communities of Fort Yukon, Chignik, and Wainwright to assess local potential for shallow coalbed methane as a potential energy source.

RELATIONSHIP WITH THE UNIVERSITY OF ALASKA

DGGS has had a long and productive professional association with the geoscientists and students in various departments of the University of Alaska. University of Alaska faculty work as project team members on many DGGS projects and provide special analytical skills for generating geochemical and radiometric-age data. University students employed as DNR/DGGS interns also are an important part of the DGGS work force. While working on current DGGS projects, the students learn a wide variety of geology-related skills ranging from conventional geologic mapping and sample preparation techniques to modern digital database creation and geographic

information systems. DGGS and the University make frequent use of each other's libraries and specialized equipment.

RELATIONSHIPS WITH FEDERAL AGENCIES

DGGS has ongoing cooperative programs with the U.S. Geological Survey (USGS), the U.S. Bureau of Land Management (BLM), and the U.S. Department of Energy. Periodically, DGGS also engages in cooperative programs with the U.S. Minerals Management Service and National Aeronautics and Space Administration (NASA). We are currently working with BLM to catalog the thousands of mineral-related reference samples stored at the Alaska Geologic Materials Center in Eagle River. DGGS also receives federal funds from matching grants for which we must compete nationally with other organizations on a yearly basis. In the past we have been successful in securing funds to support mineral inventory mapping, surficial and earthquake hazards-related mapping, volcanic-hazards evaluations and studies related to oil and gas potential in interior basins and the North Slope. We are not, however, assured of yearly success for any of our federal grant proposals. These funds, therefore, sometimes complement but do not replace state General Fund money.

ALASKA GEOLOGIC MAPPING ADVISORY BOARD

The Alaska Geologic Mapping Advisory Board guides DGGS in pursuing its goal of providing earth science information to the Alaskan public. A number of prominent leaders in the geologic community with a variety of backgrounds and a broad spectrum of experience in Alaska have agreed to serve on the advisory board. The purpose of the board is multifold:

- To identify strategic geologic issues that need to be addressed by the state.
- To inquire into matters of community interest relating to Alaska geology.
- To provide a forum for collection and expression of opinions and recommendations relating to geologic investigation and mapping programs for Alaska.
- To make recommendations toward identifying Alaska's diverse resources and promoting an orderly and prudent inventory of those resources.
- To increase public awareness of the importance of geology to the state's economy and to the public's health and safety.
- To promote communication among the general public, other government agencies, private corporations, and other groups that have an interest in the geology and subsurface resources of Alaska.
- To facilitate cooperative agreements between DGGS and other agencies, professional organizations, and private enterprise to develop data repositories and enhance the state's resource inventory and engineering geology programs.
- To communicate with public officials as representatives of groups interested in the acquisition of Alaska geologic information.
- To enlist public support for statewide geologic resource inventories and engineering geology programs.

The board held its first meeting in Fairbanks on October 22, 1995, and meets at least three times a year to discuss state needs, review DGGS programs, and provide recommendations to the State Geologist. The members solicit and welcome comments and suggestions from the public concerning state needs and DGGS programs throughout the year.

Members of the board are:

Jim Rooney
R & M Consultants, representing the engineering geology and geotechnical community
James W. Rooney, P.E., is President of R&M Consultants, Incorporated, and an original partner of this Alaskan engineering firm that celebrated its thirtieth year in business in 1999.

Curt Freeman
Avalon Development Corporation, representing the minerals industry
Curt Freeman is President of Avalon Development Corporation, a consulting mineral exploration firm based in Fairbanks, Alaska.

David Hite
Hite Consultants, representing the energy industry
Dr. David Hite is based in Anchorage, Alaska, and has extensive knowledge of the geologic issues associated with Alaska's oil industry.

Paul Layer
University of Alaska Fairbanks Geology and Geophysics Department, representing the academic community
Dr. Paul Layer is an Associate Professor of Geophysics at the University of Alaska Fairbanks and

former Head of the Department of Geology and Geophysics, a position he held for 6 years.

Irene Anderson
Sitnasuak Native Corporation, representing rural Alaskans in western Alaska
Irene Anderson is the Assistant Land Manager for Bering Straits Native Corporation. Mrs. Anderson has first-hand knowledge of the mineral, energy, and engineering geology needs throughout a wide region of rural Alaska.

Norman Phillips
Doyon, Ltd. Native Corporation, providing a perspective from the largest of Alaska's private-sector regional Native corporations
Norm Phillips is a geological engineer serving as the Resource Manager for Doyon Ltd. Native (regional) Corporation. In this capacity Mr. Phillips oversees the geologic resource conservation and development efforts for an area encompassing much of interior Alaska.

2003 ACCOMPLISHMENTS

The Division of Geological & Geophysical Surveys (DGGS) is charged by state statute to generate new, objective, peer-reviewed information about the geology of Alaska, the potential of Alaska's land for production of minerals, fuels, and construction materials, and the potential geologic hazards to its people and infrastructure. As in past years, in 2003 the Division successfully pursued multiple funding avenues to finance field teams for geological and geophysical mineral inventory mapping, generate new geologic data for North Slope energy projects, perform rural energy geologic assessments, conduct earthquake hazard investigations, and expand volcano monitoring and hazards studies in the Alaska Peninsula and Aleutian Islands.

Since 2001, Alaska has witnessed a marked increase in interest in North Slope gas and an associated interest in the detailed geology of the Brooks Range North Slope foothills in NPRA. DGGS Energy Section geologists had anticipated this trend with field studies concentrated on Brooks Range North Slope foothills geology. This work continues in 2004 and will be pursued in 2005 as well. The outcome of these investigations is a more detailed understanding of the environments in which the oil and gas source and reservoir rocks of the North Slope developed. This information, combined with interpretations of detailed seismic data, allows petroleum geologists to identify subsurface hydrocarbon reservoirs with greater certainty and success. In spite of the many millions of dollars spent on North Slope oil exploration through development each year by the private sector, the publicly available, fundamental framework geologic data generated by DGGS is an important additional contributor to exploration success, both for major companies and especially for smaller independent ventures. With a new cooperative agreement between the State of Alaska, rural communities, and Native organizations in southwestern Alaska, DGGS is initiating similar geologic studies in the Bristol Bay and Alaska Peninsula areas in 2004.

The need to reduce energy costs for rural communities and remote mining projects prompted DGGS to design a program in 1996 to investigate the potential for shallow gas resources in several promising areas of Alaska. A rural energy team composed of DGGS, University of Alaska Fairbanks, Federal agencies, and Native organizations was assembled to fully evaluate the shallow gas potential beneath rural communities. After completing field studies for coalbed methane potential at Wainwright in 2001, DGGS conducted high-resolution shallow seismic studies of Fort Yukon in 2001, and in 2003 completed field studies for coalbed methane potential in the Kobuk River, Selawik, and Angoon areas. Also in 2003, DGGS released a final report on the hydrocarbon potential of the Holitna Basin in southwestern Alaska, an area of high interest as a potential local shallow gas source for the nearby Donlin Creek gold deposit.

In its January 2004 annual report, the Alaska Minerals Commission again stressed the importance of baseline geological and geophysical mapping and commended DGGS for its quality work under difficult budgetary constraints. This mapping helps catalyze mineral exploration and has helped Alaska maintain status quo activity in recent years despite challenging economic conditions. In 2003, DGGS's geological and geophysical mapping of potentially mineral-rich areas of Alaska continued with completion of ground-truth geologic mapping in the Salcha River–Pogo area airborne-geophysical survey tract, initiation of ground-truth geologic mapping in the area of the Livengood geophysical survey, and completion of CIP-funded contract airborne-geophysical surveys in the Council area of Seward Peninsula. In addition, DGGS managed and released Federally funded airborne geophysical surveys of the Denali block area

near Paxson and the Sleetmute area near the Donlin gold deposit in southwestern Alaska.

Work on the *Minerals Data and Information Rescue in Alaska (MDIRA)* program has been widely distributed across the private sector as well as through various state and Federal agencies. After completing the prototype design and installation of the Oracle-based database in 2002, DGGS began populating the database and developing application models. Work continues on this third phase of a four-step process to interface DGGS with an Internet-accessible state and Federal interagency geologic data delivery system. As the database-development phase continues, DNR's Land Records Information Section (LRIS), DGGS, and other MDIRA cooperators have initiated development work on the fourth phase, a state-of-the-art interagency Web "portal" that will allow the public, as well as agency geologists, to locate and download the majority of all public-sector geologic data available for Alaska through a single Web site, http://www.akgeology.info. Some of the data are already available through the Web site. The finished site will include published geological and geophysical DGGS maps and reports; geographically registered outlines of geological and geophysical maps produced by government agencies; geochemical data files for rocks, soils, stream sediments, and pan concentrates; geochronologic data, land ownership status, mining claim information and plats, and descriptions of mineral occurrences throughout the state.

The Engineering Geology section entered the second year of a two-year NASA-funded project to develop advanced remote-sensing technology for ongoing application to challenging engineering-geologic and resource-assessment problems in Alaska. As a result of this effort, a DGGS geologist received one year of graduate training in remote sensing technology and is applying that knowledge to a placer gold resource-potential evaluation of the Council mining district, where DGGS also has completed airborne geophysical surveys. A major goal of the project is to help create local employment opportunities in rural communities by identifying previously unrecognized and untapped placer-mineral deposits.

The magnitude 7.9 Denali fault earthquake of November 3, 2002, provided important and significant opportunities for improving our understanding of the causes and effects of earthquakes in Alaska. Before the surface fault rupture and other effects were covered by snow and erased by erosion the following spring, DGGS performed aerial surveys of the fault and initiated field studies in cooperation with the U.S. Geological Survey and other groups to document and measure the surface effects. DGGS participated in subsequent field studies during summer 2003 to more accurately map the fault ruptures, including a previously unmapped fault that ruptured during this event. We also conducted, with UAF personnel, public-information workshops in the affected communities, which were very well received.

In addition to its earthquake-response efforts, DGGS conducted several projects in 2003 to provide the public with information about earthquake and tsunami hazards that will help reduce risks from future events. As part of a Federally funded, multi-year national program to mitigate tsunami hazards, DGGS cooperates with UAF, the state Division of Emergency Services, and coastal communities to develop tsunami-inundation maps for use in identifying evacuation zones and routes. DGGS published the first set of these maps for the Kodiak area in 2002. UAF and DGGS initiated tsunami modeling and inundation mapping for Homer and Seldovia in 2003. Finally, with support from USGS, DGGS completed the first phase of a GIS database of all available data on active faults in Alaska.

Through its participation in the Federally funded Alaska Volcano Observatory (with cooperators USGS and University of Alaska Fairbanks Geophysical Institute), DGGS expanded its roles in volcano monitoring, hazard evaluation, and information management in 2002 and 2003. Because of its recognized expertise and efficiencies in helicopter contracting, volcano geochemistry, GIS, database development, and Web-site management, DGGS maintains lead roles in these areas.

A summary of DGGS's major accomplishments in 2003 appears in the following section.

MAJOR ACCOMPLISHMENTS IN 2003

Energy Resources

- Completed new 1:63,360-scale geologic field mapping in the Kanayut River area in the central Brooks Range foothills area of the North Slope. The new bedrock- and engineering-geologic maps of the Kanayut River corridor and associated petroleum–resource evaluations will be released in 2004 for use by industry in lease sales on state and Federal lands.
- Completed geologic field studies between the Chandler and Killik rivers that document important relationships in petroleum geology of the central North Slope and NPRA. Conducted a three-day geology tour in the Brooks Range foothills for industry geologists to visit field localities criti-

cal to understanding North Slope subsurface geology. Released technical reports and posters on petroleum geology and reservoir studies of Brooks Range foothills belt rocks.

- Received funding approval from Federal and industry sources to evaluate the reservoir potential of the Bristol Bay basin and Cook Inlet region shallow gas reservoirs. These projects will complement the state's ongoing leasing and exploration licensing programs in these areas.
- Received U.S. Department of Energy funding to conduct slim-hole drilling at Fort Yukon to collect coalbed gas content and producibility data. This project, Federally funded at $350,000 per year for three years, will evaluate slim-hole exploration through production technologies for coalbed methane in rural communities.
- Conducted coalbed methane field studies of the Kobuk River region and Selawik basin in northwestern Alaska and Angoon area in southeastern Alaska. Released a final report on the shallow gas potential of the Holitna Basin in southwestern Alaska.
- Completed field investigations of the Yukon Flats basin to provide new data on its coal quality and evaluate the hydrocarbon reservoir potential for an oil and gas assessment to be completed in 2004.
- Conducted fieldwork on coal-bearing strata as part of the Delta Junction area shallow gas project. Released coal quality analyses in the initial phase of the Delta Junction area study.

Mineral Resources

- Completed the second year of a ground-truth bedrock-, surficial-, and engineering-geologic mapping project of the Salcha River–Pogo mining district airborne-geophysical survey tract and released the data collected as an interim geologic map at a scale of 1:63,360.
- Conducted the field portion of a geologic ground-truth mineral inventory survey of the northern part of the Livengood geophysical tract. These ground-truth data will provide the geologic control needed to interpret the airborne-geophysical data acquired in FY99. Support for these projects was provided in part by Federal Receipts.
- Completed a DGGS Professional Report and geologic map of private-sector geologic and geochemical data for the Delta mining area in central Alaska. This thorough publication summarizes the knowledge of the area from 25 years and more than $20 million of private-sector mineral exploration in the area.
- Conducted airborne-geophysical surveys of three prospective mineral tracts: Council survey (funded by the Alaska State Legislature) and the southern Delta River and Sleetmute surveys (funded by the Federal government). Released 66 maps and CD-ROMs containing geophysical data for three of the above areas.
- Initiated a three-year NASA-funded project in the Council mining district near Nome using high-resolution remote-sensing data and field-geologic mapping to identify previously unrecognized deposits that may be favorable sources of placer minerals.The goal is to revitalize the local economy by helping to re-establish placer mining as a means of providing local jobs and revenue.
- Compiled portions of a geographically based index of Alaska geologic maps produced by State and Federal agencies for access via the Internet. This program is supported by Federal funds.
- Compiled mineral deposit data files for public access for three 1:250,000-scale quadrangles (24,000 square miles) that encompass prospective mineral terranes. This program is supported by Federal funds.

Engineering Geology & Construction Materials

- Responded to the November 3, 2002, Denali fault earthquake by contributing to the mapping of fault displacements and evaluation of future earthquake hazards to the Trans-Alaska Pipeline and transportation corridors that cross the fault. Conducted workshops for communities affected by the earthquake, and gave many lectures on the event to scientific, emergency-management, general-public, and school audiences.
- Completed 1:250,000-scale geologic strip maps for more than 6,000 miles of transportation corridors considered for state selection. A total of 376 maps in 78 quadrangles include geology, geologic hazards, geologic materials, and data quality for the 10-mile-wide corridors and will be available via Internet as georeferenced digital images.
- Provided helicopter and ship logistical coordination for Federally funded Alaska Volcano Observatory (AVO) field operations, including a major expansion of AVO volcano monitoring capabilities in the western Aleutian Islands at Tanaga and Gareloi Volcanoes. Currently 24 of Alaska's historically active volcanoes along one of the world's most heavily used commercial air-traffic corridors are being seismically monitored, compared to four that were monitored in FY96.
- Published a Preliminary Volcano-hazard Assessment for Shishaldin Volcano and a searchable digital Bibliography of Information on Alaska volcanoes. This bibliography is fully searchable and updateable and contains 3,285 records.

- Continued maintenance and construction of the AVO World Wide Web site. The purpose of these Web pages is to improve public safety by providing timely and accurate information for the general public, management agencies, the aviation industry, local communities, and others who may be impacted by the nearby or distant effects of volcanic eruptions. Each month the Web site is accessed about 10,000 times and about 45,000 pages are viewed.

Geologic Communications

- Produced 22 new geologic maps and 12 new reports for publication, including *Alaska's Mineral Industry* annual report for 2002.
- Sold 389 professional maps and reports, distributed approximately 302 free educational publications, and responded to about 1,000 significant geologic information requests.
- Established an earthquake information page on the DGGS Web site following the Denali fault earthquake of November 3, 2002. This page alone boosted the yearly count of Web hits by 10,000 and continues to attract numerous visitors. GGS also established a restricted site with earthquake information for scientists from many agencies who are working together to research the earthquake and evaluate future hazards.
- Completed development of a prototype enterprise database for geologic information, moved the DGGS publications index into it, and began populating it with geologic data.
- With Federal funding, scanned all USGS Professional Papers and about 100 Bulletins on Alaskan geology to prepare to make them available on the DGGS Web site.
- Completed the prototype of a Web-accessible map index application for all published geologic maps in Alaska.

Geologic Materials Center

- Hosted 437 visitations to the Geologic Materials Center in Eagle River by industry, government, and academic personnel to examine samples and processed materials. These visitations generated 2,630 new processed oil and gas related microscope slides and three hard-rock mineral and oil and gas technical data reports that are now available for public examination.
- Received, stored, and inventoried seven 40-foot trailer loads of rock samples representing collections from BP Exploration (Alaska) for Arctic Alaska, Union Oil Co. of California's Amoco collection for Cook Inlet, CIRI hard-rock mineral core and oil/gas well-sample collections, Canalaska Resources hard-rock mineral core collection of Valdez Creek, Kennecott hard-rock mineral core collection from Chicken, and the released Alaska Oil & Gas Conservation Commission well samples. In total, samples for more than 174 oil and gas wells and 33 hard-rock mineral holes were received.

Key Issues for FY 2004-2005

Escalating Cost of Field Operations and Declining General Fund Budgets

Rising costs of field operations and general fund budget reductions decrease DGGS' ability to accomplish its mission. During the past 3 years, DGGS field operation costs have risen about 20 percent for geologic ground-truth geologic mapping and nearly 40 percent for airborne geophysical surveys. Much of DGGS's most valuable work for Alaska is done on the frontiers of our state. Our work provides the geologic framework that is used by the private sector to guide new energy and mineral investments. Providing this kind of information means that our field work is moving farther away from the state's limited transportation infrastructure. This, alone, adds to logistical supply costs. Our remote field programs have always required fixed-wing and helicopter support for daily access. These costs are rising dramatically. For example, our field parties utilize up to 4 hours of helicopter flying time per day to deploy and recover team members. The cost of that daily flight time has escalated yearly: $2,050 in 2000, $2,680 in 2001, $2,708 in 2002, and $3,170 in 2003. With a level or declining budget, DGGS cannot meet this kind of cost escalation while maintaining current information quality and annual field-work area coverage.

Geologic Information Accessibility

DGGS products and services are specifically aimed at supporting statewide economic development and the mitigation of natural geologic hazards that are often at the heart of the issues faced by the above clients. DGGS faces increasing demand for: (1) more widespread and faster access to our geologic data; (2) rapid delivery of special-purpose customized presentations of geologic

data in response to unique critical needs; and (3) remote delivery of active digital files of the original underlying geologic, geochemical, and geophysical data used to produce our published products. The key to meeting these demands is the use of state-of-the-art computer technology. During FY01, DGGS secured Federal funding to convert all of its maps and reports to digital format. These maps and reports were made accessible on the Internet in FY02. Funded by a Federal grant, we are implementing a Division-wide geologic database management system. This system will become part of a comprehensive Internet-accessible State-Federal interagency geologic information system that will allow the public to download active digital data files of original DGGS numeric, text, and graphical geologic data via the Internet.

Another challenge has been the recovery of previously generated geologic data that has been all but lost over the years because of the lack of resources for effective and sustained data management. As part of the current geologic data management project, DGGS and cooperating federal agencies are developing an enterprise geologic information-management system and incorporating the system into their business practices. We view this effort as the last chance to recover and stabilize decades of Alaska geologic information that is important to industry and will otherwise be forever lost. Preserving this information and making it available for present and future generations will require state commitment to its ongoing component of this system.

Commercial Energy

New oil and gas exploration in Alaska is increasingly being undertaken by smaller, independent petroleum companies that lack the depth and experience of the major oil companies. The independent companies rely heavily on publicly available geologic data on Alaska's sedimentary basins. In addition to providing this information, DGGS makes available the opportunity for these companies to sponsor and participate in field studies that provide a better understanding of the geologic framework of potential hydrocarbon sources in active and future lease areas. To this end, we actively seek both independent and major company partners in this program through frequent meetings with industry groups. Additionally, we respond to many inquiries from companies seeking the geologic information that will assist their exploration efforts in Alaska.

Rural Energy

The lack of developed sources of local energy in rural Alaska is a continuing problem that DGGS is addressing through its shallow gas program. First funded through a CIP appropriation in FY97, DGGS conducted an initial survey of the state to identify areas that have potential for supplying coalbed methane for local consumption. That work identified three high priority sites and a number of other sites of lower, but significant promise. Subsequent work has been largely funded by soliciting supplemental Federal grants. The work is now at a stage that test drilling is needed at the three high priority sites to determine whether coalbed methane gas is present in useful quantities in the subsurface.

DGGS has secured Federal and private sector funds to obtain a lightweight slim-hole drill rig and conduct exploratory drilling at Fort Yukon to obtain coal gas content data and confirm seismic horizons tested in 2000. If the lightweight drilling is successful, drilling costs can be significantly reduced to explore many of the other rural areas that have potential for shallow gas energy resources.

Major Pending Infrastructure Projects and Geologic Hazard Assessments

Alaska may be on the threshold of a major development cycle similar in scale to the construction of the trans-Alaska oil pipeline. There is increasing activity among industry and government to seek ways to expedite the construction of a delivery system to the Lower-48 for North Slope natural gas and possible extension of the Alaska Railroad to Canada. A fundamental and prudent first step in undertaking infrastructure development enterprises of this magnitude is a comprehensive, public geologic resource evaluation and geologic hazard assessment of the greater land corridors through which such construction must pass. Such assessments should be made prior to finalizing detailed alignments and prior to detailed geotechnical engineering assessments of those alignments and as a basis for evaluating permit applications. By statute AS 41.08 DGGS is charged to determine the potential geologic hazards to buildings, roads, bridges, and other installations and structures as well as inventorying the state's geologic resources, but current and projected funding is inadequate to meet this mandate.

DGGS FY04 PROGRAM

PROGRAM FOCUS

DGGS develops its strategic programs and project schedule through consultation with the many users of geologic information—state and federal agencies, the federal Congressional delegation, the Alaska State Legislature, professionals in the private sector, academia, and individual Alaska citizens. Their input to DGGS programs comes through the Alaska Geologic Mapping Advisory Board, liaison activities of the Director, and personal contact between DGGS staff and the above groups.

The FY04 DGGS program is focused on projects designed to foster the creation of future Alaskan jobs and revenue, seek more economical energy sources for rural communities, and to mitigate adverse consequences arising from geologic hazards. To maintain general prosperity, Alaska must encourage major capital investment for job creation in the state. In the near future, much of the economy will continue to depend on developing the state's natural resources. Within that future, subsurface energy and mineral resources constitute a major portion of the state's wealth. Mitigating the effects of geologic hazards helps preserve public safety and private investments by fostering sound design and construction practices.

The role of DGGS in state revenue generation and the maintenance of Alaska's economy is strategic. DGGS provides objective geologic data and information used by in-state, national, and international mineral and energy companies, construction companies, air carriers, other DNR agencies, Department of Law, Department of Community & Economic Development, Department of Transportation & Public Facilities, Division of Emergency Services, and the Federal Emergency Management Agency. DGGS geologists assist prospectors, mineral, oil, and gas explorationists, and others to explore for, dis cover, and develop Alaska's subsurface resources. DGGS is a central repository of information on Alaska geologic resources and a primary source of information for mitigating geologic hazards. To focus attention on Alaska's subsurface resource potential and geologic hazards, DGGS makes the state's geologic information available on statewide, national, and international levels.

Minerals Data and Information Rescue in Alaska (MDIRA) Program

Downsizing of federal and state agencies in Alaska during the late '80s and early '90s placed at risk an extensive body of geologic, geochemical, mineral, and mineral-development data that had been collected by federal, state, and private organizations over the past century. The data are archived in various locations offering various levels of storage capacity, quality, and accessibility. The budget exigencies for federal and state archival functions created a need to develop aggressive plans for assembling, maintaining, and most importantly, creating value from this data legacy. For the purpose of this effort, "at risk data" is defined as any data or voucher samples existing in substandard storage sites or in a mode in which data may be subject to irretrievable loss or degradation, or may be unavailable to meet the needs of its intended users. A liaison committee comprising representatives from the Alaska Miners Association, Alaska Federation of Natives, University of Alaska, Alaska Department of Natural Resources, and independent mining industry consultants guides the implementation of Alaska mineral data rescue efforts through a Federally funded program entitled *Minerals Data and Information Rescue in Alaska (MDIRA)*. Projects supported in whole or in part by this program are being undertaken by several DGGS sections. These projects are indicated by an asterisk (*) in the FY04 Program Summaries.

FY04 DIVISION EXPENSE BUDGET

Section	General Fund	CIP	Federal receipts	Interagency receipts	Program receipts	Total by Section
Energy Resource Appraisal	430.0	65.0	990.3[1]	0.0	291.0	1,731.3
Mineral Resource Appraisal	340.0	100.0	182.7	0.0	0.0	667.7
Engineering Geology/AVO	155.0	0.0	1,466.6	20.0	0.0	1,641.6
Geologic Communications	545.0	0.0	495.0	30.0	10.0	1,080.0
Geologic Materials Center	135.9	0.0	50.0	0.0	0.0	185.9
Administrative Services	299.1	0.0	50.0	25.0	0.0	374.1
Total by Funding Source	**1,905.0**	**165.0**	**3,234.6[1]**	**75.0**	**301.0**	**5,680.6**

[1]*Includes $445.0K in federal funds received through Reimbursable Services Agreements with the University of Alaska*

PROGRAM SUMMARIES

STATE GEOLOGIST/DIRECTOR

The Director's Office provides leadership and coordination for the activities of the Division through the State Geologist/Director, Secretary, and Administrative Assistant.

OBJECTIVES

1. Provide executive leadership for the Geological Development Component and act as liaison between the Division and the DNR Commissioner's Office, other state agencies, legislature, and local, federal, and private entities.
2. Stimulate discovery and development of the geologic resources of the state through support of detailed geological and geophysical surveys.
3. Provide geologic information to mitigate the adverse effects of natural geologic hazards.
4. Provide secure archival storage and efficient public access to the state's growing legacy of geologic information, and oil- and gas-related reference cores and samples.

TASKS

- Prepare annual Division funding plan including Alaska General Fund base budget, Capital Improvements budget, and federal initiatives.
- Inform Alaska state legislators, Governor's office, and Alaska federal delegation about the DGGS geologic program and its significance.
- Focus the Division's geologic expertise on addressing Alaska's highest priority needs for geologic information.

ENERGY RESOURCES

The Statewide Energy Resource Assessment program produces new geologic information about the state's oil, gas, and coal resources. With the current reduction in oil-generated revenue to the state's economy resulting from declining oil production, new significant hydrocarbon discoveries are needed to maintain or increase major revenue payments to the state. There is a continual need for acquisition of fundamental geologic data using modern concepts and techniques to enable industry to better focus its exploration in prospective areas beyond the core Prudhoe Bay area. Recent DGGS work in the central and western North Slope is stimulating industry interest in the west-central Brooks Range foothills. DGGS studies include acquiring new geologic data that assist exploration for new gas supplies for the proposed natural gas pipeline. herefore, in FY04 this program continues to focus significant effort on frontier state lands in the central North Slope and within the southeastern corner of the National Petroleum Reserve—Alaska (NPRA).

The Statewide Energy Resource Assessment program also is pursuing a solution for village and commercial enterprise energy needs in rural Alaska by drilling and testing shallow gas resources at an Interior Alaska community. he program is working to implement a comprehensive statewide coal resource data file and provide the energy component of an integrated DGGS geologic data management system.

The numerous elements of the Statewide Energy Resource Assessment program are financed from a mixture of funding sources: General Fund, Program Receipts, Federal Receipts, and Capital Improvement Project funding.

OBJECTIVES

1. Encourage active private-sector oil and gas exploration on the North Slope beyond the Prudhoe Bay–Kuparuk field areas.

2. Identify sources of energy in rural Alaska for the local generation of heat and power.
3. Provide DNR, other state agencies, and the public with authoritative information relating to the energy resources of the state so that rational policy and investment decisions are made.

FY04 ENERGY RESOURCES PROJECTS

Detailed project summaries for the following energy resources projects appear in the section *Project Summaries—FY04*:

In addition to the above projects, the Energy Resources section performs the following tasks:

- Upon request, provide written evaluations of minable coal potential for lease areas in response to requests from Division of Mining, Land and Water Management.
- Respond to verbal requests from other State agencies, Federal agencies, industry, local government, and the public for information on energy-related geologic framework and oil, gas, and coal resource data (estimated 80 responses).

MINERAL RESOURCES

The decline of oil-generated revenues suggests that Alaska must move decisively to strengthen a broader subsurface resource economic base. To achieve this goal, Alaska needs private-sector commitment of capital and talent in non oil-related as well as oil-related industries. The mineral industry, however, will not commit major company resources or succeed on an acceptable timeline without dramatic advances in understanding the geologic environments of the most prospective Alaska lands open to mineral and other geologic resource development.

Alaska has an accessible state land endowment of more than 100 million acres, much of it chosen from a 350-million-acre land pool because of perceived potential to host mineral wealth. Currently the overwhelming majority of these lands are not geologically or geophysically surveyed at the detailed level or with the focus needed to optimize mineral discovery and development. Recently, a DNR/DGGS program of integrated geological and geophysical mapping has been effective in attracting new private-sector mineral investment capital to Alaska. The purpose of the FY04 Statewide Mineral Resource Appraisal Project is to produce, on a prioritized schedule, the critical new geological surveys needed to sustain Alaska's mineral industry investments and provide management agencies with information needed to formulate rational management policy.

The Statewide Mineral Resource Appraisal project also participates in the Division-wide task of implementing a publicly accessible, comprehensive, on-line computerized Alaska geologic information database.

The numerous elements of the Statewide Mineral Resource Appraisal Project are financed from a mixture of funding sources: General Fund base budget, Capital Improvement Projects funding, Federal Receipts, and Program Receipts.

OBJECTIVES

1. Catalyze increased mineral resource exploration in three mining districts within the next three years.
2. Provide DNR, other state agencies, and the public with unbiased, authoritative information on the mineral resources of the state so that rational land policy and investment decisions can be made.
3. Provide an accurate current statistical and descriptive summary of the status of Alaska's mineral industry for calendar year 2003.

FY04 MINERAL RESOURCES PROJECTS

Detailed project summaries for the following Mineral Resources projects appear in the section *Project Summaries—FY04*:

Geologic mapping of the Salcha River – Pogo geophysical survey tract – p. 33

Geologic ground-truth inventory near Livengood, Tolovana mining district geophysical survey tract – p. 34

Airborne geophysical/geological mineral inventory – p.35

Airborne geophysical/geological mineral inventory program: Geologic mapping in the Council geophysical survey tract – p. 36

Annual Alaska mineral industry report – p. 37

*Alaska bedrock and surficial geologic map index – p. 38

*Compilation of Alaska state agency lithochemical data – p. 39

*Compilation of existing resource assessment geochemical datasets – p. 40

*Geologic maps of the Haines and Nome areas – p. 41

*Geochronologic database for Alaska – p. 42

Geology of the Amphitheater Mountains – p. 43

Bedrock geologic map of the Delta mineral belt, Tok mining district, Alaska – p. 44

*Alaska Resource Data File project (Alaska Mineral Deposit Database) – p. 45

** MDIRA-supported project (see p. 13)*

In addition to the above projects, the Mineral Resources section performs the following tasks:

- DGGS Mineral Resource geologists provide timely responses to verbal and written requests for mineral information from other State agencies, local government, industry, and the general public.
- Provide authoritative briefings about the status of Alaska's mineral industry, State support for mineral ventures, and recently acquired geophysical and geological data at professional mineral industry conventions and trade shows, and in professional journals.

ENGINEERING GEOLOGY

The Engineering Geology program addresses major engineering-geology and geologic-hazard issues that affect public safety and economic well being in developing areas of Alaska. DGGS conducts engineering-geologic mapping to determine the distribution and character of surficial deposits, their suitability for foundations, susceptibility to erosion, earthquakes and landslides, and other geologic hazards. Geologic evaluations of areas subject to major hazards like floods, earthquakes, volcanic eruptions, and landslides help predict the likelihood of future major events, forecast the severity of hazards associated with them, and suggest alternatives to avoid or reduce the effect of these hazards. In addition to General Funds, several elements of the Statewide Engineering Geology Program are partially or largely financed from Federal Receipts.

Alaska's communities at high risk from major geologic hazards comprise the majority of Alaska's citizens and a large majority of the state's corporate headquarters. In many urban areas, the state lacks the fundamental geologic data needed to guide the proper implementation of building codes, land-use zoning, right-of-way siting, property insurance regulation, and contingency planning for adverse natural hazard events. Loss of life and damage to infrastructure and buildings can be reduced through informed construction practices, land-use planning, building-code application, and emergency preparedness. However, economics and practicality dictate that mitigation measures be implemented first where risk is highest. Because hazards are not uniformly distributed, engineering-geologic and hazard maps become the first source of information about where damage is likely to be greatest and, therefore, where mitigation efforts need to be concentrated. These maps are critical for emergency planning and the allocation of emergency-response resources prior to an adverse event.

The DGGS Construction Materials Resources program provides information on the riprap, sand, and gravel con-

struction materials needed for private and public infrastructure construction. The information provided expedites the design and planning phases of state and private construction projects and helps control the cost of those projects for which this information is available. Sources of construction materials are of special concern in much of rural Alaska where coarse riprap is needed for erosion control near towns and villages, and gravel is needed for road and airport construction.

The type of surficial-geologic mapping conducted for purposes of locating sources of construction materials and identifying geologic hazards is also of benefit for locating placer-mineral deposits. For this reason, engineering-geology personnel often participate in teams with DGGS' mineral-resources geologists to map areas of interest for minerals exploration.

OBJECTIVES

1. Help protect public safety and health by providing information on geologic hazards as they affect human activity.
2. Provide geologic information to help lower the costs of construction design and improve planning to mitigate consequences arising from hazardous natural geologic events and conditions.
3. Provide reliable engineering-geologic data for informed land-use decisions by the government and private sector.
4. Identify sources of sand, gravel, rip-rap, stone, and other geologic construction materials required to create the infrastructure, roads, and other land-based transportation corridor improvements necessary to support expanded development of natural resources and other local economic activities in Alaska.
5. Identify potential sources of placer minerals in participatation with Minerals Resources mapping teams.

FY04 ENGINEERING GEOLOGY PROJECTS

Detailed project summaries for the following Engineering Geology projects appear in the section *Project Summaries—FY04*:

**MDIRA-supported project (see p. 13)*

In addition to the above projects, the Engineering Geology section performs the following tasks:

- Produce written evaluations of potential hazards in areas of oil exploration leases, land disposals, permit applications, etc., and respond to verbal requests for information from other State agencies, local government, and the general public (estimated 250-300 responses annually).
- As part of the Alaska Coastal Management Program, conduct reviews of Coastal Policy Questionnaires and consistency applications to determine compliance with the program's geophysical hazards standard (6 AAC 80.050).
- Conduct post-event hazard evaluations in response to unexpected major geologic events (e.g., earthquakes, volcanic eruptions, and landslides), providing timely information dispersal to the public via electronic as well as traditional methods, and providing event and continuing hazard information to appropriate emergency management agencies.

GEOLOGIC COMMUNICATIONS

The Geologic Communications Section edits, designs, publishes, and disseminates technical and summary reports and maps about Alaska's geologic resources generated by the Division's technical projects. The maps and reports released through this section are the state's primary vehicle for widely disseminating factual information and data relating to its subsurface mineral and energy wealth, its geologic construction materials, and its engineering geology. These documents focus attention on Alaska's most geologically prospective and useful lands and are the authoritative geologic basis for many of the state's resource-related land policy decisions. They also encourage geologic exploration investment leading to resource discoveries and subsequent major capital investments. Timely availability of geologic information from DGGS is a significant factor in stimulating Alaska's economy and mitigating the adverse effects of geologic hazards.

The geologic information desk staff provides geologic information to the public on a wide range of topics including permafrost, mineral and energy resources, prospecting, and earthquakes, and assists customers in understanding geological and geophysical maps and data. Staff also manage sales of geologic reports, maps, and data and prepare displays and represent the division at geologic conferences and events.

The section produces an annual report about division activities and accomplishments; publishes newsletters to communicate division progress and advertise recent publications; designs, edits, and produces technical and educational geologic maps and reports in printed and digital formats; reviews metadata for division projects; manages the DGGS library so that reports (by DGGS and other related agencies) are available and locatable; and participates in outreach activities such as classroom presentations, science fair judging, or helping teachers plan earth science units.

The section's Digital Geologic Database has three primary objectives: (1) to establish a spatially referenced geologic database system in a centralized data and information architecture with networked data access for new DGGS geologic data; (2) to create a functional on-line system that allows the public to find and identify the type and geographic locations of geologic data available from DGGS and then view or download the selected data; and (3) to cooperatively integrate DGGS minerals-related data with data from other agencies through a MDIRA-sponsored Web site <http://akgeology.info>.

The Geologic Communications Section provides primary computer and GIS service and support to DGGS staff and streamlines information delivery to the public. Information Technology projects completed this year include upgrading the Solaris operating environment to Solaris 9, installing a DHCP server, and upgrading the SAMBA server, as well as configuring a Gigabit LAN connected via Cisco Catalyst switches. DGGS IT staff also assisted with several other DGGS projects, most notably the Geologic Database Project by installing and maintaining hardware and software for the Oracle server.

The section established a Web site and began extensive use of the Internet in FY98 to increase the availability of the Division's information and to provide state and worldwide access to the Division's geologic information base. These efforts have developed into a major project to establish a state–federal multi-agency Internet-accessible Alaska geologic database management system. Federal funding was obtained to scan, convert to digital format, and post the entire DGGS suite of publications on our Web site. Additional funds have been secured to do the same for all U.S. Geological Survey Bulletins and Professional Papers in the DGGS library and make them available via the World Wide Web.

The Geologic Communications Section is financed through the General Fund, Federal Receipts, and Program Receipts.

OBJECTIVES

1. Disseminate new, accurate, unbiased, Division-generated data on the geology of Alaska to the public at large, to DNR policy and regulatory groups, and to all other interested parties within one year of its acquisition.
2. Preserve and manage the data and knowledge generated by the Division's special and ongoing projects in an organized, readily retrievable, and reproducible form consistent with pertinent professional standards.
3. Focus public awareness on Alaska's most prospective mineral and energy lands.

FY04 GEOLOGIC COMMUNICATIONS PROJECTS

Detailed project summaries for the following Geologic Communications projects appear in the section *Project Summaries—FY04*:

**MDIRA-supported project (see p. 13)*

GEOLOGIC MATERIALS CENTER

The Geologic Materials Center (GMC) archives and provides public access to non-proprietary oil, gas, and coal drill cores and drill-cutting samples, rock cores from mineral properties, and processed ore, oil, gas, coal, and source-rock samples. These samples are used by government and private-sector geoscientists to improve the odds of finding new oil, gas, and mineral deposits that will maintain the flow of state revenues and provide in-state employment. The Geologic Materials Center Project is financed from the General Fund budget and in-kind contributions directly from industry. The private sector contributes the cost of delivering all new samples, sample preparation and analyses, sample logs, and data logs.

The holdings of the GMC are a continually growing asset that is compounding in value over time at little cost to the state. The GMC facility is staffed by one permanent Division geologist, one federally funded non-permanent geologist, and numerous private-sector volunteers. The GMC has formal cooperative agreements with the U.S. Geological Survey, the U.S. Minerals Management Service, and U.S. Bureau of Land Management to house and control their Alaska geologic materials. A voluntary 14-member board advises the GMC project leader and DGGS on matters pertaining to the GMC.

OBJECTIVES

1. Enhance oil revenues and in-state employment opportunities by making oil, gas, and mineral exploration more effective.
2. Advance the knowledge of the geology and resources in Alaska's low-lying structural basins favorable for oil or gas discovery.
3. Advance the knowledge of Alaska's mineral potential by making available representative samples of ores and drill cores from mineral deposits throughout the state.

A detailed project description for the Geologic Materials Center appears in the section *Project Summaries–FY04* (p. 62)

ADMINISTRATIVE SERVICES

The Administrative Services group provides financial control and administrative support for all other projects in the Geological Development component including: securing lowest costs for goods and services; maintaining, and when necessary, procuring vehicles for field work; coordinating travel arrangements and appropriate paperwork to minimize travel expenses and field party subsistence costs; negotiating a contract for field helicopter services; administering and monitoring grants and contracts; tracking and reporting project expenditures to ensure cost containment within budget for all projects; mail/courier services; assistance in personnel matters; petty cash; and any other support necessary to further increased efficiency or savings in acquiring knowledge of the geology of Alaska.

OBJECTIVE

1. Facilitate the efficient execution of DGGS programs and projects.

TASKS

- Monitor grants and contracts (Federal, Interagency, and Program Receipts) to ensure deliverables are produced on schedule and within budget; ensure expenses are properly billed against grants and contracts and receipts are collected promptly.
- Provide accurate, timely reporting of project expenditures and current balances; encourage prudent money management.
- Decrease the cost of transportation to the field by coordinating personnel travel and supply shipments; negotiate long-term helicopter contracts in cases where helicopters are necessary; coordinate Division vehicle use and decrease requests for reimbursement for personal vehicle mileage.
- Make travel arrangements and complete travel authorizations to ensure use of the lowest cost travel options.
- Provide communication between remote field camps and office, allowing for unforeseen circumstances, expediting field supplies, and ensuring safety of field personnel.
- Assist staff with personnel matters; inform staff about changes in personnel rules or benefits and ensure that all personnel paperwork complies with applicable rules and regulations. Estimate future personnel salaries and benefits to assist management in making human resource decisions necessary to efficiently accomplish the division's mission.

PROJECT SUMMARIES—FY04

Alaska faces the challenge of developing a viable economy from our natural resources while protecting an environmental legacy that is the envy of many. The Department of Natural Resources' Division of Geological & Geophysical Surveys is an integral partner in the team of state agencies that strive to meet this challenge. The output from our projects provides the fundamental science required to guide critical policy decisions, encourage exploration investment, mitigate the effects of geologic hazards, and improve the quality of life for all Alaskans.

The overviews of the following 40 projects that are being pursued by DGGS in FY04 span the scope of our legislative mission statement. Each of these projects is making a positive difference for Alaska. Many are implemented through various cooperative agreements with other state and federal agencies, universities, in-house project teams, and contracts. We leverage state General Funds through these arrangements so that our work provides the greatest possible benefit from the public's investment

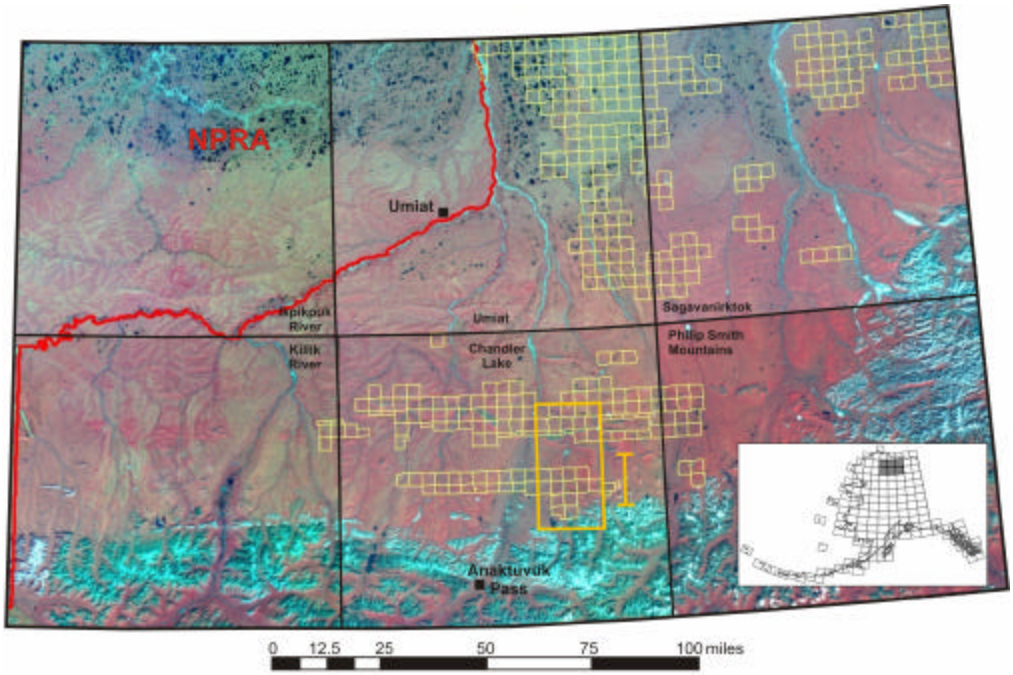
CONTENTS

BROOKS RANGE FOOTHILLS PROGRAM

This program, in its fifth year, is focused on developing detailed sequence stratigraphic and depositional framework, evaluation of reservoir quality, and sampling for source rock potential of selected units in the Brooks Range foothills south of the National Petroleum Reserve–Alaska (NPRA) (see map). While directed by DGGS, the program is a result of a multi-agency collaboration that includes the Division of Oil & Gas, the U.S. Geological Survey, the University of Alaska Geology Department, and others. The program was developed in direct response to the needs of major and independent oil and gas companies interested in development on the North Slope. These companies also contribute directly to the financial support of the program.

During the 2003 field season, detailed stratigraphic sections were measured through portions of the Torok, Nanushuk, and Tuluvak formations near the Chandler and Colville rivers south and west of Umiat. Results from these studies have identified key sequence-bounding unconformities and potential reservoir facies that are important to understanding the distribution of potential hydrocarbon reservoirs in the foothills belt and in coeval deepwater strata to the north in the northeastern NPRA. Over the past five field seasons, oil-stained sandstones have been observed in the Torok and Nanushuk formations over a large geographic area in the Chandler Lake, Umiat, and Sagavanirktok quadrangles. A second study included detailed facies analysis of the Fortress Mountain Formation and is providing new information on the stratigraphic architecture of these basin-margin deposits and timing of the tectonic evolution of the Brooks Range and Colville Basin. In addition, exposures of the Carboniferous Lisburne Group and the Triassic Otuk Formation were examined near the mountain front in the Chandler Lake Quadrangle, providing new information on the depositional sequences and source rock potential of these units. Products resulting from these studies will include: Measured sections and summary of the petrology and reservoir quality of selected sandstone bodies (released winter FY05); and a report summarizing the sequence stratigraphy and reservoir quality of Cretaceous rocks (released winter FY05).

Also completed during the 2003 field season was detailed bedrock geologic mapping of the Kanayut River area (1:63,360 scale) and a structural cross section of the Cobblestone Creek area. This work will serve as a basis to reconstruct the structural geometry and evolution of the range front and foothills belt, and their influence on the thermal history of the area. Additional field checking and air-photo interpretation of the Chandler Lake, Ikpikpuk River, Killik River, Umiat, Lookout Ridge, Utukok River, and Point Lay quadrangles have been completed. These maps, part of a series of maps being digitized by the U.S. Geological Survey in a collaborative project with this program, are in review and scheduled for publication in FY04 and FY05. These maps will incorporate modern stratigraphic nomenclature and consistent style of structural annotation and will be the basis of a new revised geologic map of the North Slope.



Active lease sales, central foothills, North Slope, Alaska, outlined in light yellow. Gold lines indicate area of 2003 Kanayut River Statemap project and location of structural cross section.

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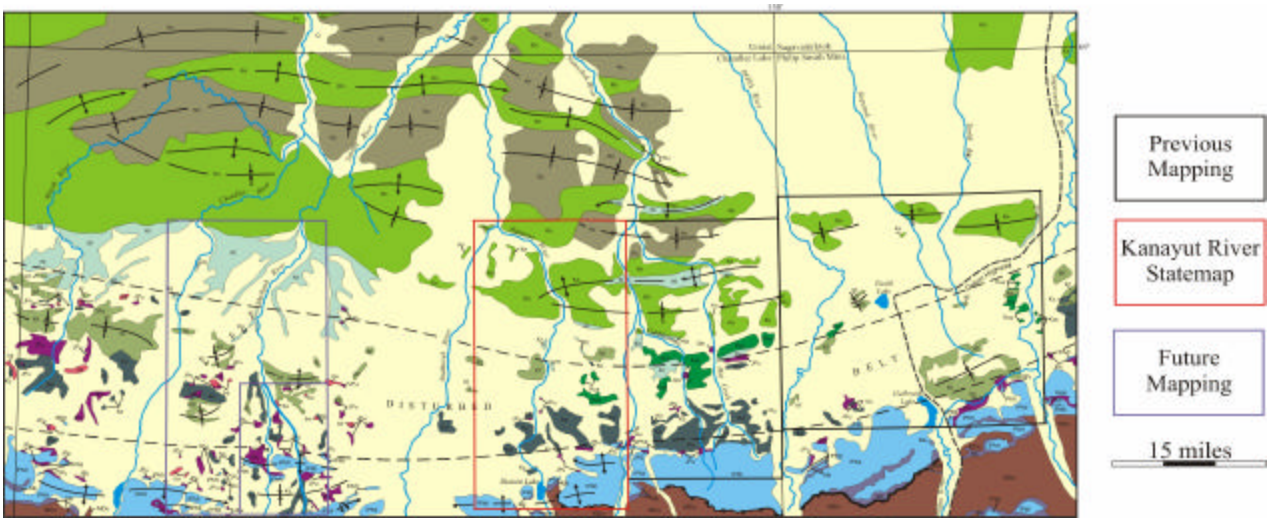
KANAYUT RIVER STATEMAP PROJECT

Geologic mapping in the Kanayut River area of the Chandler Lake Quadrangle is part of the National Cooperative Geologic Mapping Program, which partners the U.S. Geological Survey and state geological surveys to prioritize the geologic mapping requirements of the nation, and to promote publication of geologic maps. The Kanayut River area was selected for detailed geologic mapping because it encompasses stratigraphic and structural elements important to understanding the geology and oil and gas potential of the central Brooks Range foothills belt and the adjacent North Slope (see map). Surface geology mapped in the Kanayut River corridor can then be correlated to geology mapped elsewhere in Arctic Alaska and to subsurface stratigraphic units in the Prudhoe Bay–Kuparuk area, the Colville Delta, and to recent exploration wells drilled in the northeastern NPRA. Recent oil discoveries in the northeastern NPRA and on adjoining State lands immediately to the east have generated strong interest in new exploration play concepts for Jurassic and Cretaceous strata in frontier areas of the North Slope. This interest is reflected in recent State and Federal lease sale results. In addition, the growing demand for natural gas has resulted in considerable interest in the Brooks Range foothills belt as a viable gas province. Many petroleum explorationists, particularly those in smaller companies that are newcomers to Alaska geology, rely on DGGS for continuity of mapping and stratigraphic studies to improve understanding of the geologic framework of the North Slope and advance their search for hydrocarbons.

During the summer of 2003 DGGS conducted 21 days of geologic field mapping in the Chandler Lake C-2 and northern half of the B-2 quadrangles. Objectives included: (1) conducting stratigraphic studies of key map units including the Kanayut



Conglomerate, Lisburne Group, Okpikruak Formation, Fortress Mountain Formation, and the Torok and Nanushuk formations to support map unit descriptions and facies interpretations; (2) evaluating the reservoir potential of selected map units; (3) correlating map units and structural interpretation of the Ellesmerian and Lower Brookian sequences to understand the structural transition from parautochthonous rocks of the northeastern Brooks Range to allochthonous rocks of the north-central Brooks Range and adjacent foothills belt and to constrain the timing of deformation; (4) sampling for organic geochemical analysis to evaluate hydrocarbon source rock potential in upper Triassic through Lower Cretaceous rocks; and (5) petrographic studies to differentiate units and define provenance for Lower Brookian rocks. This information will be used to produce a comprehensive geologic map of the Kanayut River corridor and to evaluate the petroleum source rock and reservoir potential of selected map units.

This map will advance DGGS's 1:63,360-scale geologic mapping westward along the Brooks Range mountain front and adjacent northern foothills. Products resulting from this project will include: A comprehensive geologic map at 1:63,360 scale with supporting text (released June FY04); a surficial geologic map, and a construction material resources and geologic hazards map (released Fall FY05). All samples will be archived and available in a geographically referenced relational database.

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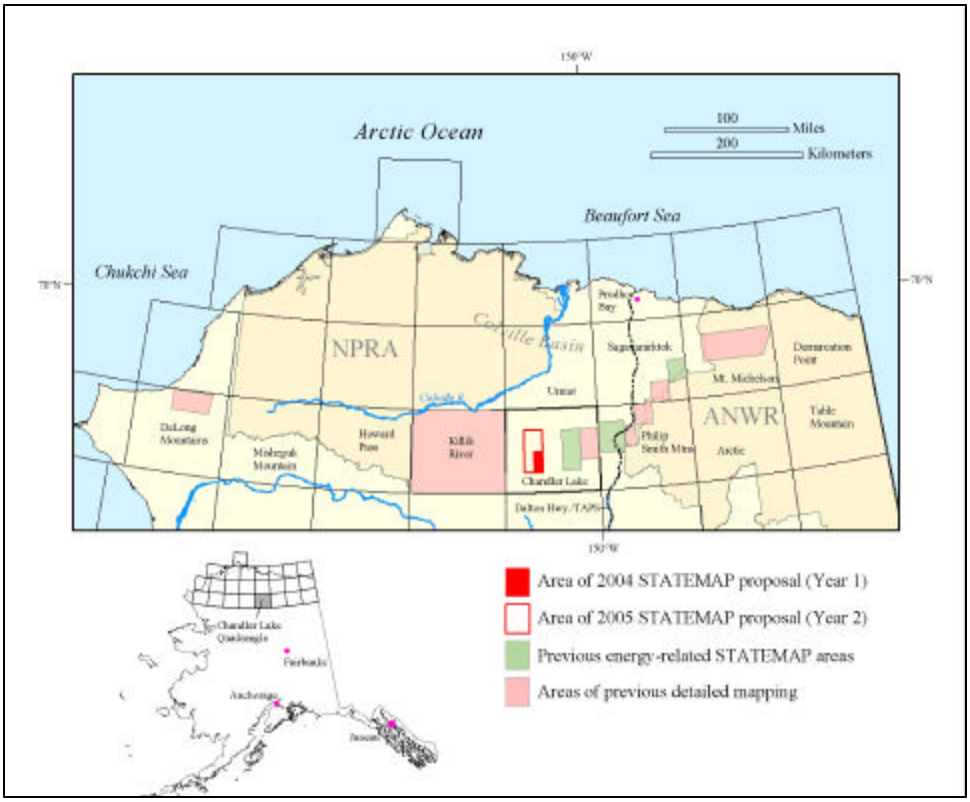
SIKSIKPUK RIVER STATEMAP PROJECT

DGGS proposed new geologic mapping in the Siksikpuk River area of the Chandler Lake Quadrangle as part of the USGS-funded FY04 STATEMAP program. The area lies on the southern limit of Alaska's remote North Slope, long known for its petroleum potential. This portion of the northern Brooks Range foothills is thought to be strategic for natural gas in particular, and is currently under lease to both major and smaller independent petroleum exploration companies. New mapping in this area provides an opportunity to study, in outcrop, the stratigraphy and structural styles of the source and reservoir rocks that enrich the Colville basin to the north. The proposed mapping (see figure) will extend structural and stratigraphic models developed during previous mapping along the foothills to the west, providing baseline geologic data to the private and public entities that identify, develop, and manage resources that area.

DGGS will augment this STATEMAP mapping project with detailed stratigraphic, sedimentologic, and structural studies. Our stratigraphic analyses include detailed observations of key formations from which we develop representative geologic models. Sedimentologic investigations include both hydrocarbon source and reservoir potential studies. Sampling and analyses will include geochemistry to identify source rock potential and to differentiate between similar lithologies. Paleontologic analyses will be performed to define and correlate units and to identify source potential. Isotopic age determinations may be used to date minerals where appropriate to model uplift histories. Thin section samples will also be collected for petrographic determination of lithology and microfacies to differentiate units, characterize porosity and permeability, and determine sediment transport pathways. Porosity and permeabil-ity testing of samples will also help define their reservoir potential. All of the above studies will contribute to interpretations of structural relationships and resource implications.



DGGS mapping and associated research in the map area support not only new foothills exploration by industry currently active on the North Slope, but also encourage smaller companies to enter the region as well. Products of this two-year project will include a published GIS-based comprehensive geologic map and reports of analytical results. Preliminary results and a draft geologic map will be released by DGGS at the end of the first year (mid 2005). The analytical data, geologic map, and interpretations will be published in final form at the end of the second project year.

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ALASKA NORTH SLOPE GAS HYDRATE ENERGY RESOURCE EVALUATION

Gas hydrates may become an important global source of clean burning natural gas. Gas hydrates are potentially a large untapped onshore energy resource that is thought to underlie a large area of the North Slope of Alaska within the hydrate pressure–temperature stability field (fig. 1A). While methane, propane, and other gases can be included in the hydrate structure, methane hydrates appear to be the most common in nature. To develop a complete regional understanding of this potential energy resource, DGGS, USGS, and BLM have entered into an Assistance Agreement to assess gas hydrate energy resource potential in northern Alaska. The primary objective of this project is to assess the recoverable resource potential of onshore natural gas hydrate and associated free-gas accumulations on State, Federal, and Native lands on the North Slope of Alaska. This project will actively collaborate with the BP-Alaska–U.S. Department of Energy (USDOE) methane hydrate research project, which is presently evaluating the energy resource potential of the known gas hydrate accumulations in and around the Prudhoe Bay oil field.

Gas hydrates are naturally occurring ice-like substances composed of water and gas, in which a solid water-lattice accommodates gas molecules in a cage-like structure. Gas hydrates are widespread in permafrost regions and beneath the sea in sediment of outer continental margins. The amount of methane sequestered in gas hydrates is probably enormous, but estimates of the amounts are highly speculative. The production history of the Russian Messoyakha gas hydrate field demonstrates that gas hydrates are an immediate source of natural gas that can be produced by conventional methods. The production potential of the Eileen or Tarn gas hydrate accumulations (fig. 1B) has not been adequately tested; but it is the present focus of two USDOE-led industry R&D gas hydrate research programs. Numerous technical challenges must be resolved before this potential resource can be considered an economically producible reserve.

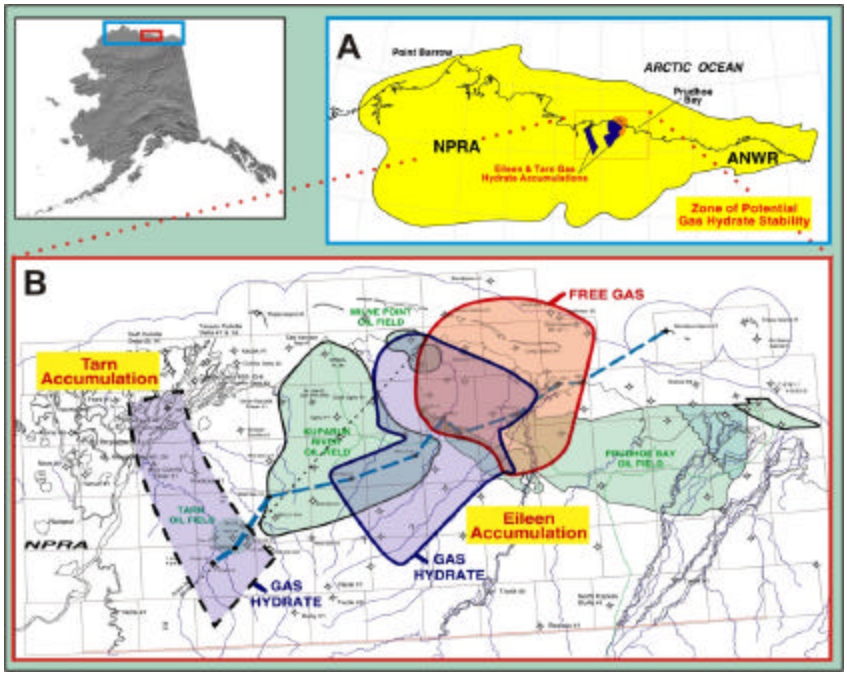

Figure 1. A. Stability field of North Slope gas hydrates.
B. Eileen and Tarn gas hydrate accumulations of the Prudhoe Bay area.

The BLM–USGS–DGGS Alaska gas hydrate assessment project is divided into three concurrent phases over five years. Phase I will study the known gas hydrate accumulations within and near existing development infrastructure of the Eileen and Tarn trends. Phase II will identify and characterize undiscovered gas hydrate accumulations in NPRA, ANWR, and the other relatively sparsely drilled areas between the Canning and Colville rivers. Phase III will develop a comprehensive assessment of the recoverable resource potential of gas hydrates and associated free-gas accumulations in northern Alaska.

DGGS and BLM are currently evaluating pingo growth along fault zones in the Eileen trend area as a tool for detecting subsurface gas hydrates seeps. A preliminary report detailing the presence and form of pingos along the subsurface fault zones in the Eileen area will be released in FY04. If successful, further work in FY05 will expand the pingo–fault study westward into NPRA, and field sampling of ice cores from pingos will be conducted to analyze for gas hydrate presence.

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BRISTOL BAY BASIN PETROLEUM RESERVOIR CHARACTERIZATION, SOURCE POTENTIAL, AND HYDROCARBON RESOURCES

The Bristol Bay program is a 3-year geologic research effort funded by the U.S. Department of Energy's Alaska Energy Technology Development Laboratory and the Bristol Bay Native Corporation, in cooperation with the Alaska Division of Oil and Gas (DOG) and DGGS. As lead agency, DGGS will collect and interpret new data using modern analysis and methodology and will produce the first public, electronically available, quantitative hydrocarbon reservoir data set. Our work with these data will codify the fundamental reservoir characteristics of potential basin targets, place the reservoir data in a sequence stratigraphic framework, and summarize the hydrocarbon potential of this frontier basin (fig. 1). Project data will be published in peer-reviewed DGGS reports, accessible on the DGGS website, and will catalyze future exploration interest and resource-target models, particularly by small independent companies. Participating geologists are from DGGS, DOG, University of Alaska Fairbanks, Purdue University, Bristol Environmental & Engineering Services Corporation, and USGS. All rock samples will be archived and indexed at the DGGS Geologic Materials Center in Eagle River.

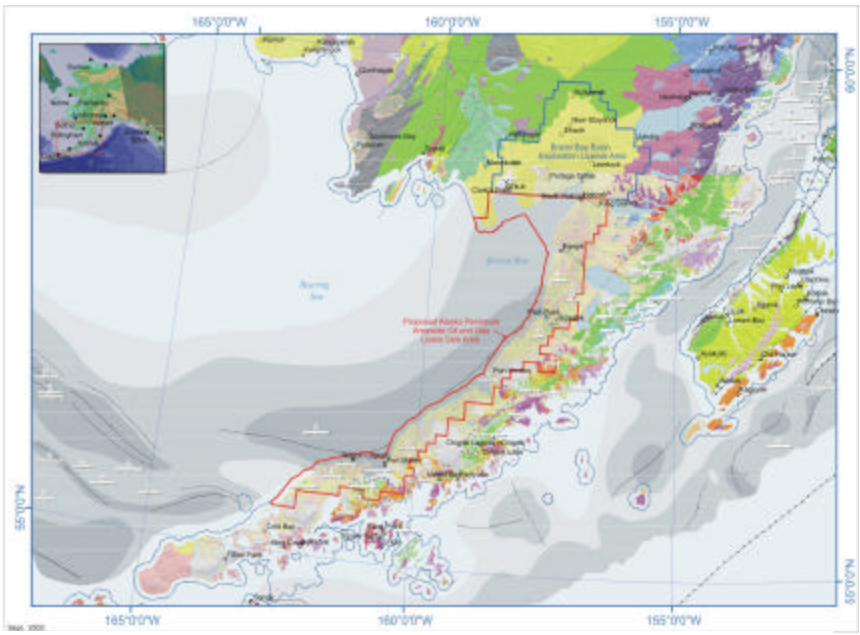

Fig. 1. Alaska Peninsula, Bristol Bay geology and lease areas (DOG)

Reservoir characteristics will be quantified using petrophysics (approximately 300 porosity and permeability samples), detailed petrographic analysis, facies analysis, and stratigraphic section measurements. Data will be entered into a GIS-compatible Access database. Publicly available subsurface seismic and well-log data will be integrated to develop a subsurface cross section that suggests the extent of the principal target reservoirs. Regional magnetics and gravity will be incorporated into the basin analysis.

Subsurface and surface samples for apatite fission track analysis will provide data for burial and uplift history. Organic geochemistry of source rock material from wells and outcrop will provide details of thermal maturity and source rock affinity (gas or oil prone). Defining stratigraphy through facies analysis, depositional environment interpretation, and net sand assessment will be based on measured outcrop exposures. Tying the seismic profiles to the several available wells further defines basin architecture (fig. 2) and delineates potential hydrocarbon play types.

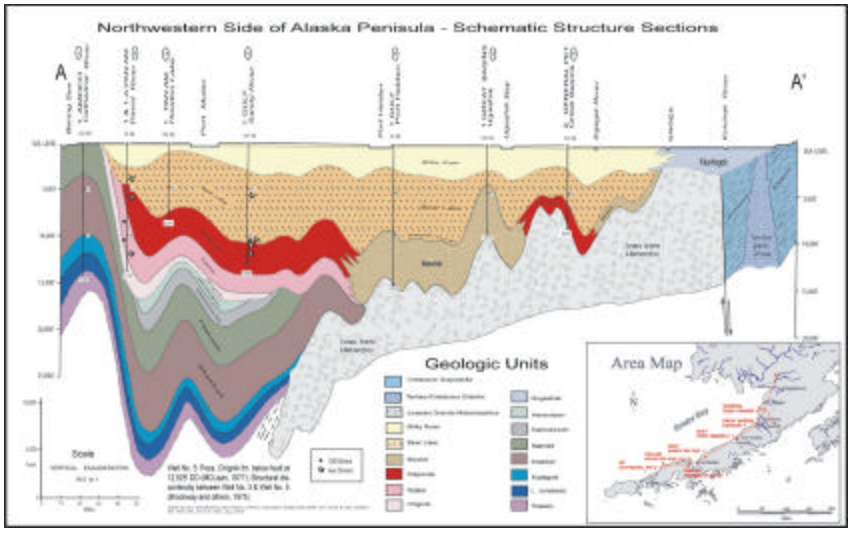

Fig. 2. Cross section based on drill hole logs, northeast side Alaska

Quarterly progress reports to the U.S. Department of Energy's Alaska Energy Technology Development Laboratory, and interim technical reports will facilitate distribution of new field work data to the public. A DGGS interim report on porosity, permeability, and measured sections is anticipated in the fall of 2004.

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RESERVOIR CHARACTERIZATION OF TIGHT SANDS, COOK INLET BASIN

Reservoir characterization is the detailed and complex process of identifying and quantifying properties that influence the distribution and migration of oil or gas within a reservoir. Studying the geologic details of tight sandstones that are potential reservoirs allows simulation of economic scenarios essential to reservoir development and production management. This project is a federally-funded, one-year joint grant with the University of Alaska Fairbanks and includes a coalbed methane water disposal study.

The Cook Inlet Basin (fig. 1) covers some 14,000 mi^2 and is filled with more than 25,000 feet of Tertiary non-marine sediments. The Cook Inlet project will investigate and summarize the reservoir characteristics of a representative collection of Cook Inlet tight sandstone units, including Eocene West Foreland Formation, Oligocene Hemlock Formation, late Oligocene to middle Miocene Tyonek Formation, upper Miocene Beluga Formation, and Pliocene Sterling Formation. Oil production occurs from the Tyonek, Hemlock, and West Foreland formations.

Figure 1 Cook Inlet basin occupies the area bounded by faults.

Two types of gas occur in Cook Inlet: Associated and nonassociated. Associated gas occurs with oil reservoirs in the West Foreland, Hemlock, and lower Tyonek formations (fig. 2), has heavy hydrocarbon signature, and exhibits a carbon isotope ratio that links it with a Jurassic source. Nonassociated gas occurs in the upper Tyonek, Beluga, and lower Sterling formations from less than 7,500 feet. This gas is dry and has a carbon isotope ratio that indicates its source as coals in the Tyonek, Beluga, and Sterling formations. Both gas types occur in the Tyonek, Beluga, and lower Sterling formations. The current study will provide publicly available data about the reservoir quality of a representative suite of sandstones from the Tertiary age section.

Fifty samples have been collected from Cook Inlet drill core. These core samples have been analyzed for petrophysics, including porosity and permeability, grain density, grain volume, bulk volume, sample weight, and capacity for flow to nitrogen. Detailed petrography and point count (400 framework grains per thin section) will be completed on 25 thin sections. The specific clast composition of sandstone is fundamental to understanding its reservoir potential and for understanding sandstone provenance. Grain types, grain boundaries, grain interfaces, and cement types and timings are factors controlling reservoir characteristics, and critical to oil and gas assessments. Core information will be placed in a regional framework by integrating seismic-profile data at the Alaska Division of Oil and Gas. A peer-reviewed DGGS final report will be published in spring 2004 and will be available from the DGGS Web site. All rock and locations will be archived at the DGGS Geologic Materials Center, Eagle River, Alaska.

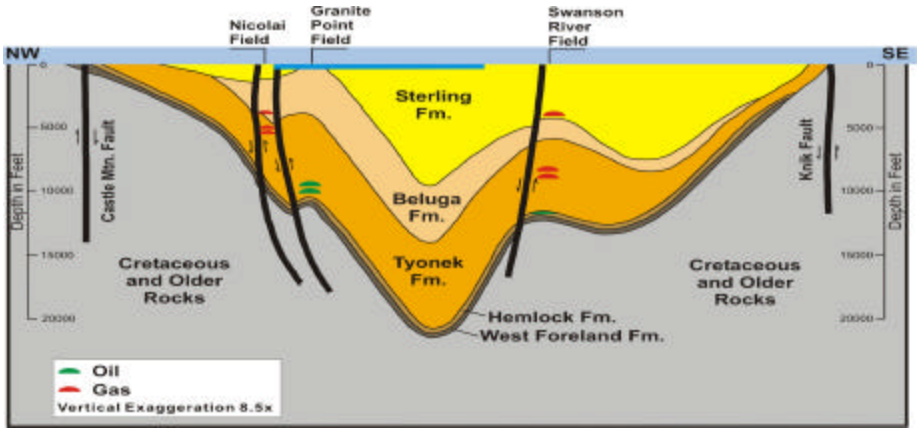

Figure 3 Diagrammatic geologic cross section of Cook Inlet basin.

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COALBED METHANE FOR RURAL ALASKA ENERGY

The Division of Geological & Geophysical Surveys (DGGS) is evaluating the potential for local sources of coalbed methane to meet Alaska's rural energy needs in communities situated on or near coal basins. The presence and quantity of producible coalbed gas in these basins remains unknown and untested until test drilling can assess the quantity and quality of this resource. Coalbed methane can be locally produced and consumed using shallow well fields and short pipelines. This relatively inexpensive, clean coalbed methane could have considerable positive impact in villages that are now isolated from the power grid by reducing pollution problems from existing diesel generators, making a local gas production company possible, and allowing viable industrial development in areas that now use subsidized or imported energy.

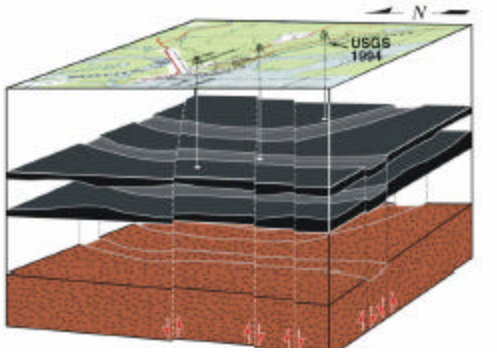
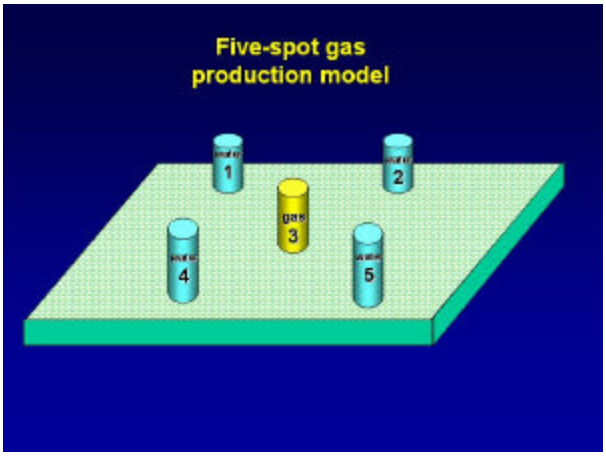
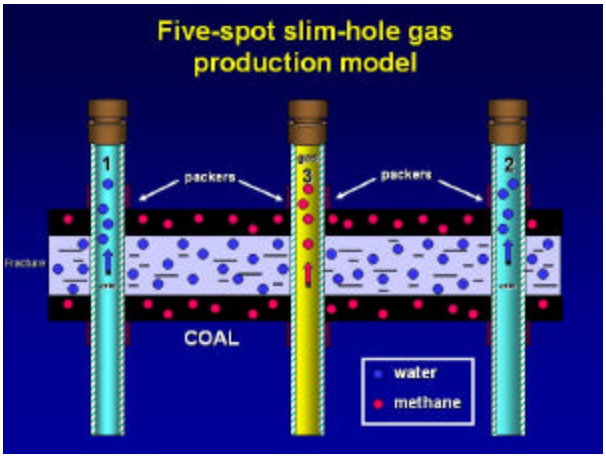


Fig. 1. Shallow seismic survey at Fort Yukon suggests coal underlies entire community.

DGGS, in cooperation with the U.S. Geological Survey (USGS) the U.S. Bureau of Land Management–Alaska (BLM), and the University of Alaska Fairbanks, has formed an Alaska rural energy team to evaluate Alaska's remote coal basins for their shallow coalbed gas potential. The rural energy team is focusing on three sites that have the highest potential for coalbed gas: (1) Wainwright on the western North Slope, (2) Fort Yukon in the Yukon Flats, and (3) Chignik area communities on the Alaska Peninsula.

A seismic-reflection study of approximately 8.5 line miles conducted by DGGS and the Kansas Geological Survey in 2001 indicates a number of significant reflectors, including an upper 60-foot-thick lignite (at about 1,200 feet depth) and at least two more significant coal-bearing zones may be present beneath the upper lignite. These "coal intervals" are laterally continuous beneath the entire community (fig. 1). A multi-year grant from the Fairbanks-based Arctic Energy Office of the U.S. Department of Energy (DOE), along with Department of Interior funding (BLM and USGS), and Evergreen Resources Alaska expertise, will allow the Alaska rural energy team to reenter a 1994 USGS climate test hole for hydrologic testing, and conduct geophysical logging of the drill hole. In years two and three of the DOE grant, the team will drill and evaluate a novel five-spot production test designed to utilize a slim-hole (4" diameter) drill rig. The five-spot production technique consists of a central gas-producing well surrounded by four dewatering wells (figs. 2 and 3) and differs from conventional coalbed methane wells that produce water and gas from each well. The five-spot technique, if successful, will greatly reduce production costs associated with coalbed methane development in rural areas. UAF conducted a study of the facility needs and an economic analysis of the costs associated with coalbed gas production for heat and electrical power generation at Fort Yukon. This report, funded by DGGS, will be released in FY04. Interim reports on the Fort Yukon drilling study will be released in FY05 and FY06, followed by a final report on drilling and completion of slim-holes to develop shallow gas resources released in FY07.





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EVALUATION OF EFFECTS OF DRILLING AND COMPLETION FLUIDS IN SHALEBED METHANE RESERVOIRS—RED DOG MINE

Preliminary tests of organic-rich shales at the Red Dog Mine in northwestern Alaska (fig. 1) suggest potential exists for shalebed methane gas. Red Dog Mine is the world's largest lead–zinc mine with reserves for 50 plus years of mining. Annual costs for diesel-based energy at the Red Dog Mine exceed $20 million. To find an alternative source of energy at the mine, the U.S. Department of Energy funded a pilot program in 2001 to develop tools and techniques for obtaining key reservoir parameters from slim holes (fig. 2). Several slim-hole test wells were drilled to target the Kuna and Kayak formations that are shale gas bearing. Ethylene glycol is used to keep the holes from freeze-up during drilling and following completion. Glycol may affect porosity and permeability measurements as they relate to gas production from shalebed and coalbed reservoirs, as well as create permanent formation damage. DGGS is providing project oversight and geologic framework for a Reimbursable Services Agreement (RSA) to the University of Alaska Petroleum Engineering Department to evaluate the effects of glycol on porosity and permeability measurements on slim-hole drill core from the Red Dog Mine (fig. 3). The overall project objective is to use the permeability measurements to assess formation damage during drilling and well completion.

Figure 1


Figure 2. Slim-hole drill rig in open pit

Project tasks include:

- Measure permeability and porosity from cores obtained from the slim-holes drilled at the Red Dog Mine.
- Evaluate formation damage arising from the drilling and completion fluids used at the Red Dog Mine.
- Initiate a program designed to establish laboratory capability at the University of Alaska Fairbanks that can support future shallow gas (primarily coalbed methane and shalebed gas) exploratory drilling and production operations in Alaska.

As coal seams are reservoirs with natural pores, the fracturing fluid can cause more damage to the permeability than in the case of matrix reservoir. Evaluation and research of the resulting damage caused by the fracturing liquid to the permeability of the coal become very important. For this, a system for measuring the permeability of coal core in quasi-triaxial mode will be developed. The system can be used to measure coal sample permeability simulating reservoir temperature and pressure before and after fracturing. The system consists of three main components: Sample holder, hydraulic pressuring system, and pumping system. Experiments will be conducted using specialized equipment that simulates as closely as possible the "down-hole" conditions of pressure and temperature. Background information concerning slim-hole drilling at the Red Dog Mine will be collected to support the design of the experiments to measure permeability and assess formation damage.


Figure 3. Slim-hole drill core

A final project report documenting project methodology, results, conclusions, and recommendations for drilling and completion of slim-holes to develop shallow gas resources in Arctic Alaska will be completed by the end of FY04. Funding ($37.0) for this project is from State CIP and U.S. Department of Energy funds. The U.S. Geological Survey and the U.S. Bureau of Land Management are cooperative partners in this effort as well.

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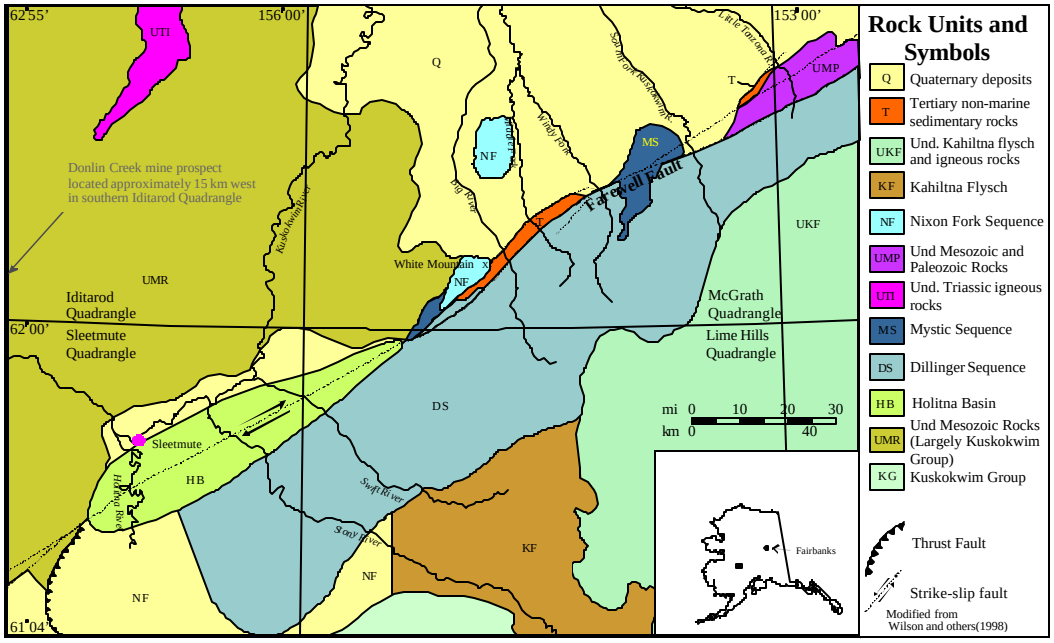
HOLITNA BASIN ENERGY RESOURCE STUDY

The Division of Geological & Geophysical Surveys (DGGS) is conducting a study to evaluate the potential for gas in Tertiary strata of the Holitna basin. A local source of gas in the Holitna basin would meet the needs of local communities and promote development of nearby mineral resources, such as the Donlin Creek Mine. The lack of detailed information available regarding the geology of the basin discourages future exploration of the basin's energy resources.

The Holitna basin is a subsurface strike-slip basin south of the Kuskokwim River, near the village of Sleetmute (see map). Gravity data suggest that the basin contains up to 6,000 meters of Tertiary-age sedimentary rocks. The location of the basin astride the Farewell fault suggests that its formation and fill are related to right-lateral strike-slip motion on the fault. No exposures of the basin-fill exist, making direct evaluation of its gas potential possible only through an expensive drilling program. However, exposures of Tertiary-age coal-bearing rocks are present northeast of the Holitna basin, along a northeast-trending belt that straddles the Farewell fault.



During the FY01 and FY03 field seasons the Division conducted detailed stratigraphic studies of Tertiary strata in this belt to characterize the reservoir quality of sandstones and conglomerates, and the gas potential and thermal maturity of coals and carbonaceous shales. Preliminary organic geochemical samples collected during the FY01 season indicated good gas source potential and some liquid hydrocarbon potential. Organic geochemical samples collected during the FY03 season will provide more detailed information on the gas and liquid hydrocarbon source potential of non-marine strata thought to fill the basin. In addition to fieldwork, DGGS has completed an integrated interpretation of high-resolution aeromagnetic and detailed regional gravity datasets covering the basin. Interpretation of these geophysical datasets will result in a better understanding of the origin, deep structure, and sedimentary fill of the basin. As part of this project, DGGS will complete a 1:63,360-scale geologic map of the Sleetmute A-2 Quadrangle that covers the Paleozoic through Mesozoic strata in the southern part of the Holitna lowlands. The dataset resulting from this project will allow DGGS to make meaningful general conclusions regarding the hydrocarbon potential of the basin.

Products from this project will include a report summarizing the reinterpreted high-resolution aeromagnetic and gravity data and a summary report on the gas potential of the Holitna basin that incorporates all available data. These reports are in preparation and will be released in FY04. The geologic map of the Sleetmute A-2 Quadrangle will be released in FY04.

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DELTA AREA COALBED METHANE, STRUCTURAL AND STRATIGRAPHIC PROJECT

The Division of Geological & Geophysical Surveys (DGGS) is evaluating the potential for coalbed methane in the Delta area of the eastern middle Tanana basin. The presence and quantity of producible coalbed gas in this basin is unknown and untested. The study area (fig. 1) extends from the Jarvis Creek coal field (Mt. Hayes Quadrangle) to north of Delta Junction (Big Delta Quadrangle) and westward to the Wood River coal field (Fairbanks Quadrangle) (fig. 2). Industry is actively exploring this region for its coalbed methane potential to meet energy needs in Delta Junction and Fort Greely. This area is isolated from the existing power grid and diesel and heating fuel are currently used to generate electricity and heat in residences and businesses.

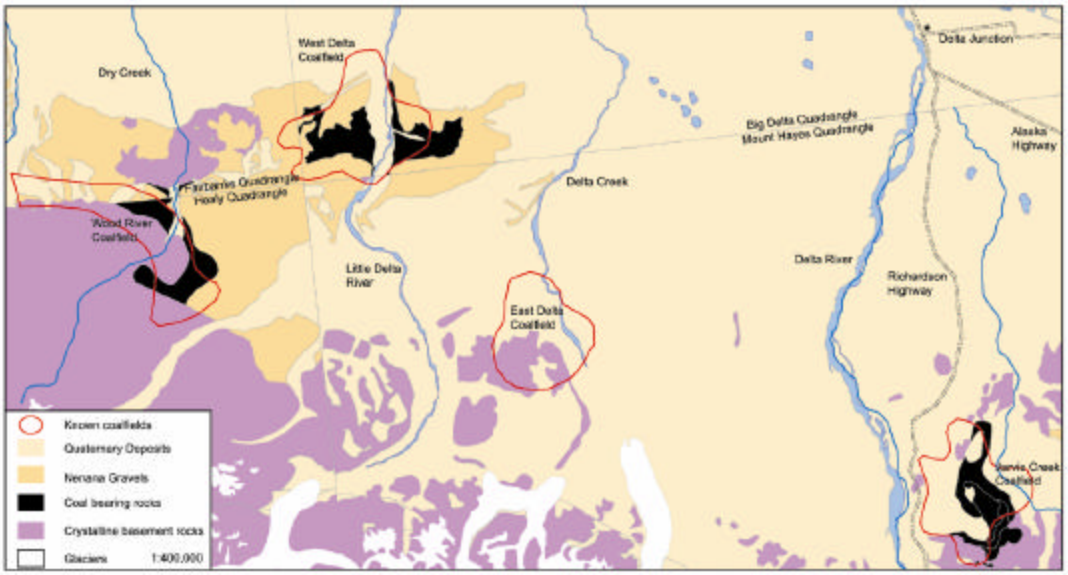

Figure 1. Generalized geology of the eastern middle Tanana Basin (modified from Wilson and others 1998)

The Delta Area project is a 2-year project that began July 1, 2002, and will be completed June 30, 2004. Project work will consist of the following tasks: (1) Compile existing literature, geologic map data, and structural, geologic, sedimentary, paleontologic, and thermal information, including borehole data from Jarvis Creek; (2) research and evaluate basin hydrogeologic data; (3) reconstruct the tectonic history of the basin; (4) interpret regional and local stresses utilizing GIS software, geo-referenced LANDSAT, and aerial photos; (5) identify potential fracture networks, evaluate fluid flow regime, and model coalbed gas generation-to-production pathways; and (6) conduct volumetric analysis to predict potential coal reserves or gas resources for the basin. Interim products will be publicly released on a timely basis, including coal quality data. Products at the end of year one included summary reports on preliminary findings of reconnaissance-level fieldwork and coal quality. Final products at the completion of the project (FY04) will include a final report summarizing the coalbed methane potential and final release of coal quality data. This project is funded by a combination of General Funds, State CIP, and industry Program Receipts.

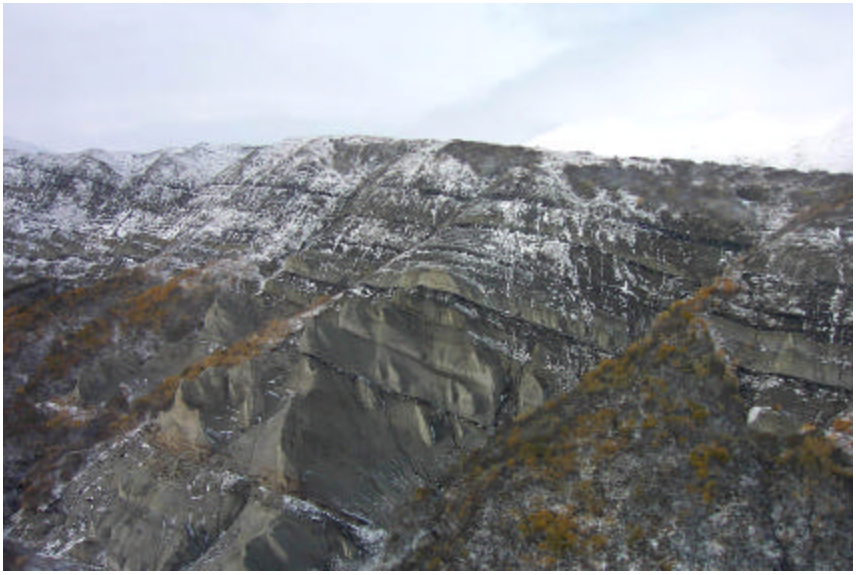

Figure 2. Coal-bearing Suntrana Formation at Wood River Coal Field on Coal Creek.

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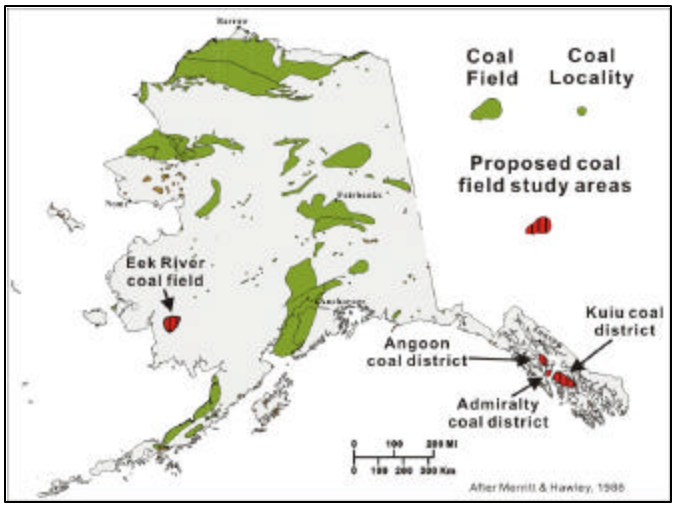
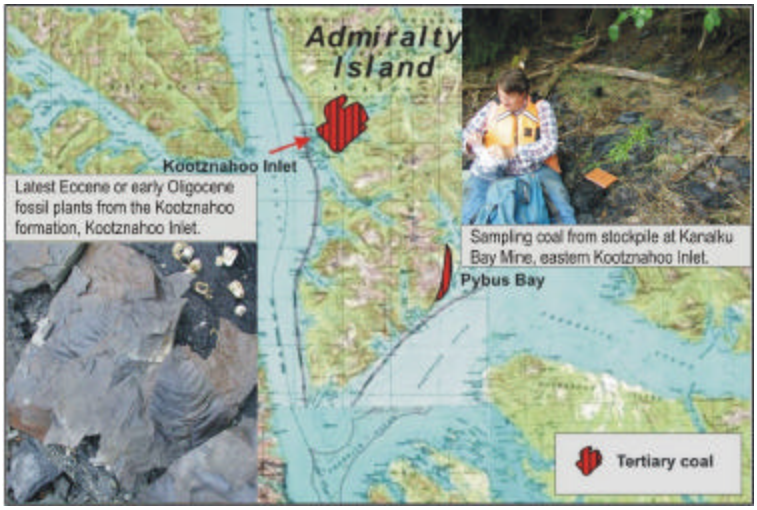
ALASKA COAL DATABASE
NATIONAL COAL RESOURCE DATA SYSTEM

The long-term goal of the Alaska Division of Geological & Geophysical Surveys' (DGGS) participation in the U.S. Geological Survey's (USGS) National Coal Resource Database System (NCRDS) cooperative program is to record all known coal resources in Alaska and archive them in a single, readily accessible database available at the USGS Web site: http://energy.er.usgs.gov/products/databases/USCoal/. Encoded and formatted data for northwestern, northern, interior, southcentral Alaska, Alaska Peninsula, Nulato, and Kobuk coal fields of Alaska have been included previously in the Alaska portion of the NCRDS.



In the course of gathering information to expand the NCRDS database that contains coal quality and stratigraphic data for Alaska, the need for collecting new coal samples and current stratigraphic data was recognized. The most frequent problems encountered were lack of accurate outcrop and coal sample locations, suspect coal quality analyses, and insufficient stratigraphic control. The coal quality and stratigraphic context of coals in both the southeastern Alaska and the Eek River areas (see map above) are poorly known. This NCRDS project will help alleviate the lack of data for these coal fields by providing significant new coal quality data and accurate stratigraphic information for meaningful coal resource assessment. Rural and roadless communities in both regions currently import costly diesel fuel to provide heating and electrical power generation, particularly Petersburg and Angoon (southeastern Alaska) and Kwethluk and Eek (southwestern Alaska). With the advent in the 1980s of coalbed methane as a major domestic energy source, nationwide assessments of coal basins for their coalbed gas potential are currently underway. Expanding our knowledge base of coal resources in southeastern and southwestern Alaska may well benefit rural communities by providing a local source of solid fuel or coalbed gas to meet energy needs. Additionally, local energy sources prevent potentially catastrophic fuel spills that may occur during the transportation and storage of liquid fuels.

During the 2003 field seasons, DGGS and BLM staff conducted field examinations of coal outcrops in the Angoon coal district of southeastern Alaska (see map at right). A paleontologic study of Tertiary flora was conducted to determine age and paleoenvironment of coal deposits. During the 2004 field season we will visit the Eek River coal locality. Coal samples will be submitted for proximate, ultimate, and trace-element analyses, and selected samples will be submitted for gas isotherm studies. Products from this project are: (1) encoded and formatted coal resource data of new samples submitted to the USGS in their USTRAT and USALYT computer files for inclusion into the Alaska coal database, and (2) a final report detailing coal resource data for each of the coal fields, to be released in September 2005.



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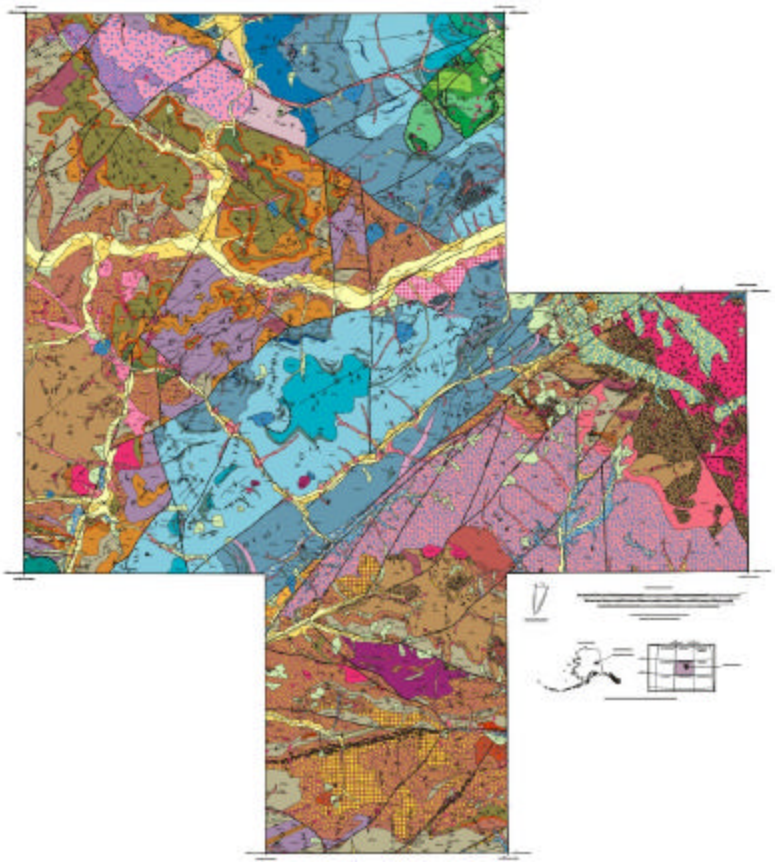
GEOLOGIC MAPPING OF THE SALCHA RIVER–POGO GEOPHYSICAL SURVEY TRACT



During the summer of 2002 DGGS conducted a 57-day geologic field mapping project within the boundary of the 1,032-square-mile Salcha River-Pogo airborne geophysical survey (see figure). This work took place during the second year of a planned 3-year study. Mapping was funded by the federal STATEMAP program and the Alaska Geophysical/Geological Mineral Inventory Program. The objective of this project is to produce 1:63,360-scale geologic maps of a portion of the geophysical tract, and to evaluate the area's mineral resource potential. Currently the southern portion of the geophysical survey is of intense interest to the mineral exploration industry since it includes the Pogo property (a high-grade, plutonic-related, 5.5-million-ounce gold deposit). Other promising gold targets occur throughout the study area, and there is the potential for ultramafic-hosted, platinum-group-element lode occurrences.

Several greenschist- to amphibolite-facies metamorphic rock suites were delineated by previous 1:250,000-scale mapping of the Big Delta Quadrangle. Contact relationships between these suites are poorly known, and there are conflicting interpretations in the literature. To clarify these issues, DGGS carefully located these boundaries, determined appropriate contact types, and documented the area's complex polydeformational structural history. DGGS also delineated many previously unrecognized, high- and low-angle faults, and has determined their sense of motion, cross-cutting relationships, and timing. Identification of low-angle structures is important because they host some of the gold deposits in Interior Alaska (e.g., Pogo, True North). We are also testing a 75-km left-lateral displacement model for the prominent high-angle, northeast-striking Shaw Creek fault; it has important implications for offset of lithologic units, as well as the Pogo deposit and Richardson mineral district.

Our detailed mapping enabled us to define many new metamorphic–stratigraphic units. These metamorphic rocks have been intruded by numerous igneous/meta-igneous suites of varying ages (Devonian to Tertiary) and compositions (felsic to ultramafic[?]). Plutonic, metavolcanic, metaplutonic, orthogneiss, and augen gneiss units were classified based on rock textures, petrographic observations, mineralogy, modal percentages determined from feldspar staining, major- and minor-oxide and trace-element compositions, ages, geophysical signatures, and trace-element-indicated tectonic origin. Consistent classification facilitates comparison of these rocks, and evaluation of their mineral favorability.

A reconnaissance geologic map of the Pogo area, and results of geochemical analyses from DGGS's summer 2000 reconnaissance work were published in June 2001. DGGS's analytical work from summer 2001 was published in June 2002, and analytical work from summer 2002 will be released in spring 2004, once the metadata file is completed. A preliminary geologic map of the Big Delta C-3, SW¼ of the C-2, and NE¼ of the B-3 quadrangles (see figure) was compiled and submitted to the STATEMAP committee in May 2003; paper copies are available to the public. DGGS plans to incorporate additional mapping, which encompasses the Pogo gold deposit in the NW¼ of the Big Delta B-2 Quadrangle (blank southeastern corner of the project area), into this preliminary map. The final map will be published in spring 2004.

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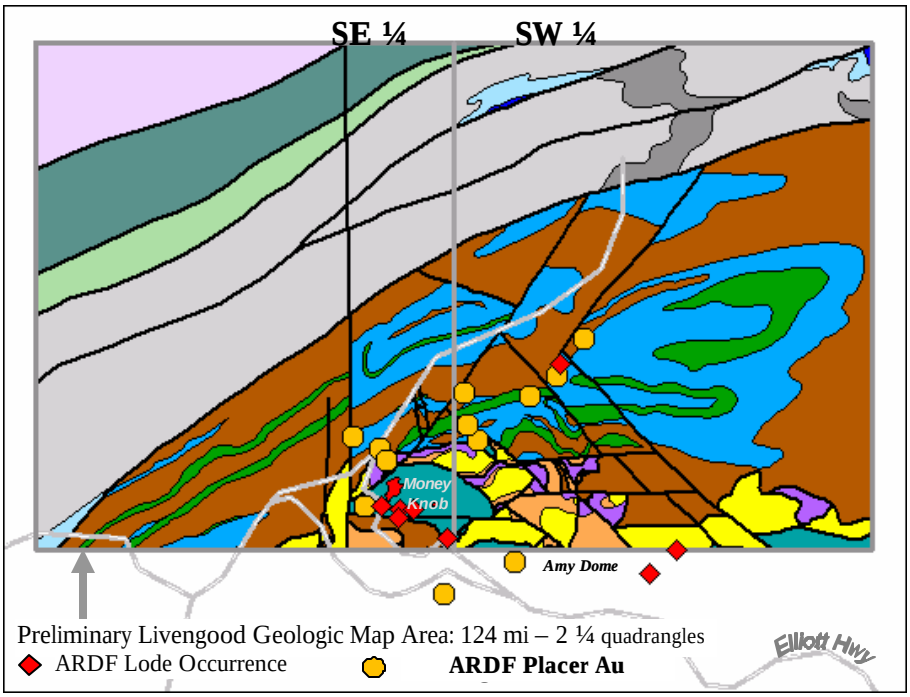
GEOLOGIC GROUND-TRUTH INVENTORY NEAR LIVENGOOD, TOLOVANA MINING DISTRICT GEOPHYSICAL SURVEY TRACT

During the summer of 2003 DGGS geologists mapped the northern 124 square miles of the 229-square-mile Livengood airborne geophysical survey tract. The geophysical (DGGS et al., 1999) and geologic projects are part of the Alaska Airborne Geophysical/Geological Mineral Inventory Program, a multi-year investment by the State of Alaska to expand Alaska's geologic and mineral resources knowledge base, catalyze future private-sector mineral exploration and development, and guide state planning. The geologic mapping is also funded in part by the U.S. Geological Survey STATEMAP program. Products from this project, a series of 1:63,360-scale geologic maps and supporting geochemical and geochronologic data, will be published by June 2004.

The Livengood area, located about 75 miles northwest of Fairbanks in the northern part of the Tintina gold belt, contains the most productive portion of the Tolovana mining district. Ten inactive and two active placer gold mines exist in or adjacent to the study area (Alaska Resource Data Files <http://ardf.wr.usgs.gov/>). Approximately 500,000 ounces of placer gold have been mined from the Livengood subdistrict since 1914, with most production from Livengood Creek near the center of the map area. Currently Livengood Creek flows to the southwest, suggesting that the lode source of the placer gold should be east of Livengood. A DGGS study shows, however, that Livengood Creek previously flowed to the northeast and reversed to its present-day direction of flow after the placer gold was deposited. The Money Knob area, which contains a concentration of eight lode gold prospects, was the former headwaters of the creek and is an obvious source area for the placer gold. Mineral exploration is currently active along the Money Knob–Amy Dome ridge. There is also potential for ultramafic-hosted precious-metal deposits throughout the area. The Elliott Highway, numerous mine roads, and Trans-Alaska Pipeline corridor provide excellent accessibility to the mineralized zone. Existing infrastructure would facilitate mineral development of this area.



Livengood is in an approximately 150-mile-long east–west-trending belt containing back-arc (?) related 90 Ma granite and syenite intrusions with associated lode and placer gold occurrences. A complex suite of units that vary widely in age and composition hosts the intrusions. DGGS focused efforts to define these units and determine their contact types and relationship to the mineralization. In the northwestern part of the map area, geophysical data indicate units are bounded by high-angle, possibly strike-slip faults. In the southeastern part of the map area, which contains all of the known gold occurrences, DGGS recognized abundant high- and low-angle structures that may either provide pathways for ore-bearing fluids or truncate mineralized zones. A pending radiometric age on the Amy Creek unit will determine the nature of these contacts. Numerous Cretaceous dikes intrude the rock packages in the Money Knob area. Their reduced compositions and porphyritic and brecciated textures are consistent with those of other shallow plutonic-related gold systems (e.g., Brewery Creek, Donlin Creek). New geologic interpretations in the map area will lead to better understanding of the geologic framework for ore deposits in the Livengood area and should stimulate increased mineral exploration investment within this regional belt of rocks.

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AIRBORNE GEOPHYSICAL/GEOLOGICAL MINERAL INVENTORY

The Airborne-Geophysical/Geological Mineral Inventory project is a special multi-year investment to expand the knowledge base of Alaska's mineral resources and catalyze private-sector mineral development. The project seeks to delineate mineral zones on Alaska state lands that: (1) have major economic value; (2) can be developed in the short term to provide high-quality jobs for Alaska; and (3) will provide economic diversification to help offset the loss of Prudhoe Bay oil revenue. Candidate lands for this project are identified on the basis of existing geologic knowledge, land ownership, and responses to solicitations for nominations from Alaska's geologic community. Products resulting from these surveys generally include (1) 1:63,360-scale aeromagnetic and airborne-electromagnetic maps; (2) 1:63,360-scale bedrock and surficial geologic maps; (3) 1:63,360-scale mineral occurrence maps; and (4) various other geological, geochemical, and geophysical data compilations.

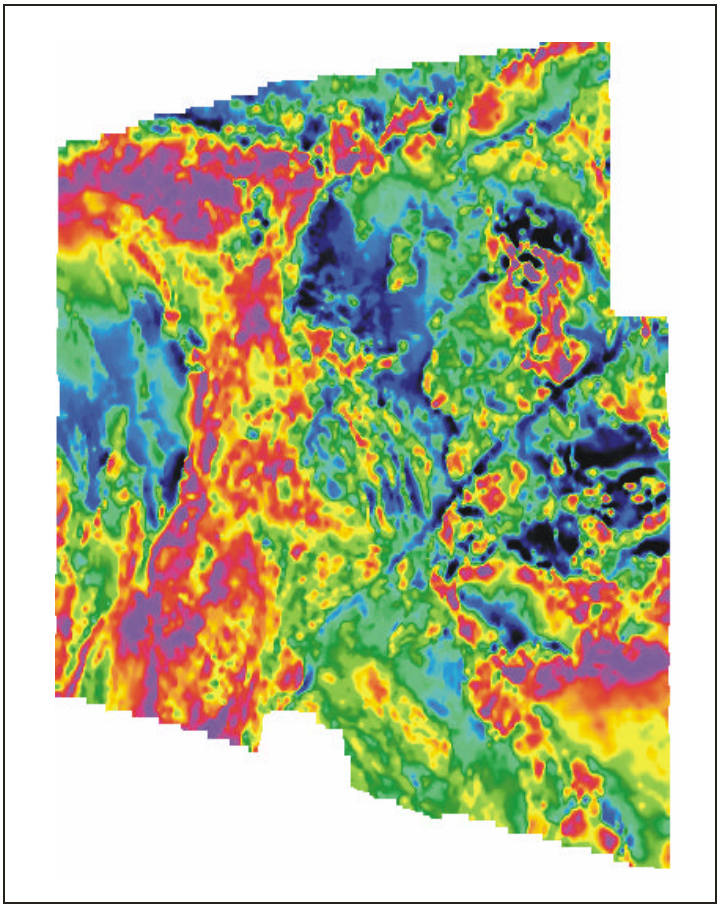

Figure 1: Aeromagnetic map of the Nome area.

Because funding is limited in FY 2004, no new geophysical surveys are being acquired. The funding made available to DGGS will be used to provide more information to the mining community for a minimum of six airborne geophysical surveys that were flown previously. Data for the six survey areas (Circle, Valdez Creek, Nyac, Nome, Fairbanks, and Richardson) were acquired during 1993 and 1994. The products DGGS requests when contracting for airborne geophysical data have evolved over the past ten years to accommodate changing technology and archiving techniques. Our current standard contract deliverables include plot files and good quality topographic data combined with full-color image data that were not technologically feasible ten years ago. The figure shown is an example of the geophysical data that will be combined in color with topography. Products will include numerous maps with topography, maps with data contours, plot files, and CD-ROMS of industry standard databases.

The geophysical data that are produced from these studies are released to the public and will be used for decades. The procedures being done on the 1994 and 1995 data will essentially revise presentation of the data to enable the user to more easily use the data and see more detailed information. The products will be released in the first half of 2004.

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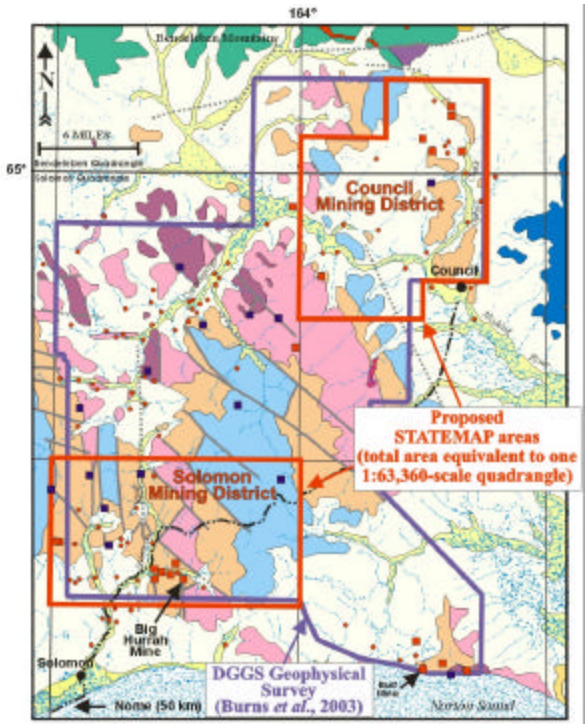
AIRBORNE GEOPHYSICAL/GEOLOGICAL MINERAL INVENTORY PROGRAM: GEOLOGIC MAPPING IN THE COUNCIL GEOPHYSICAL SURVEY TRACT



A 618-square-mile area containing parts of the historic Council, Casadepaga, and Solomon placer gold mining districts of the Seward Peninsula, Alaska, was the focus of the most recent airborne geophysical survey released by the Alaska Division of Geological & Geophysical Surveys (DGGS) as part of the State-funded Airborne Geophysical/Geological Mineral Inventory Program (survey outlined in blue; fig. 1). The geophysical data were released in February 2003 (Burns et al., 2003). The area, centered between Solomon and Council, is located ~50 km east of Nome. In November 2003, DGGS submitted a proposal for funding through the Federal STATEMAP program. If funded, this project will be part of a joint, 1:63,360-scale geologic mapping and mineral resource assessment study by DGGS and the U.S. Geological Survey, scheduled to begin in summer 2004. DGGS's studies will concentrate on the southwestern and northeastern portions of the geophysical survey (areas outlined in red; see figure). The northeastern area is also the focus of an ongoing NASA-funded remote-sensing project (through DGGS).

Placer mining in the study area has produced more than 1 million ounces of gold since the turn of the century. The region also contains numerous lode gold (e.g., Big Hurrah mine) and stratabound base-metal sulfide occurrences. Detailed geologic mapping and sampling will be undertaken to document the geochemistry, age, distribution, orientation, and regional structural controls on the area's low-sulfide, gold-bearing quartz vein systems. The nature and extent of the stratabound base-metal occurrences are poorly known. In order to evaluate their economic potential, the internal metamorphic stratigraphy, age, and tectonic history of the Nome Group will be investigated, as well as details of the base-metal mineralizing systems.

In preparation for planned summer 2004 field work, geophysical data and color-infrared aerial photographs are being analyzed. These data suggest additional detailed mapping is required to reconcile inconsistencies with existing 1:250,000-scale mapping. Numerous sets of high-angle faults are reflected in the geophysical data throughout the study area, including prominent northwest-, northeast-, and north-trending faults, as well as more subtly expressed west–northwest- and north–northwest-trending faults. A volcanic vent site and associated flow deposits of basaltic composition, and presumed Quaternary(?) age, are located near the intersection of a north-trending, geophysically-inferred, high-angle fault and a prominent northwest-trending fault zone. The vent axis trends northwest, indicating that some of the high-angle faulting in the region may be associated with Quaternary(?) tectonic–magmatic events.

Draft geologic maps of the STATEMAP study areas will be completed by June 2005.

Burns, L.E., Fugro Airborne Surveys, and Stevens Exploration Management, 2003, Plot files of the airborne geophysical survey data of the Council area, Seward Peninsula, Alaska: Alaska Division of Geological & Geophysical Surveys Geophysical Report GPR 2003-1, 1 CD-ROM.

Forbes, R.B., Evans, B.W., and Thurston, S.P., 1984, Regional progressive high-pressure metamorphism, Seward Peninsula, Alaska: Journal of Metamorphic Geology, v. 2, p. 43–54.

Miller, E.L., Calvert, A.T., and Little, T.A., 1992, Strain-collapsed metamorphic isograds in a sillimanite gneiss dome, Seward Peninsula, Alaska: Geology, v. 20, p. 487–490.

Patrick, B.E., 1988, Synmetamorphic structural evolution of the Seward Peninsula blueschist terrane, Alaska: Journal of Structural Geology, v. 10, p. 555–565.

Till, A.B., Dumoulin, J.A., Gamble, B.M., Kaufman, D.S., and Carroll, P.I., 1986, Preliminary geologic map and fossil data, Solomon, Bendeleben, and southern Kotzebue quadrangles, Seward Peninsula, Alaska: U.S. Geological Survey Open-File Report 86-276, 71 p., 3 plates.

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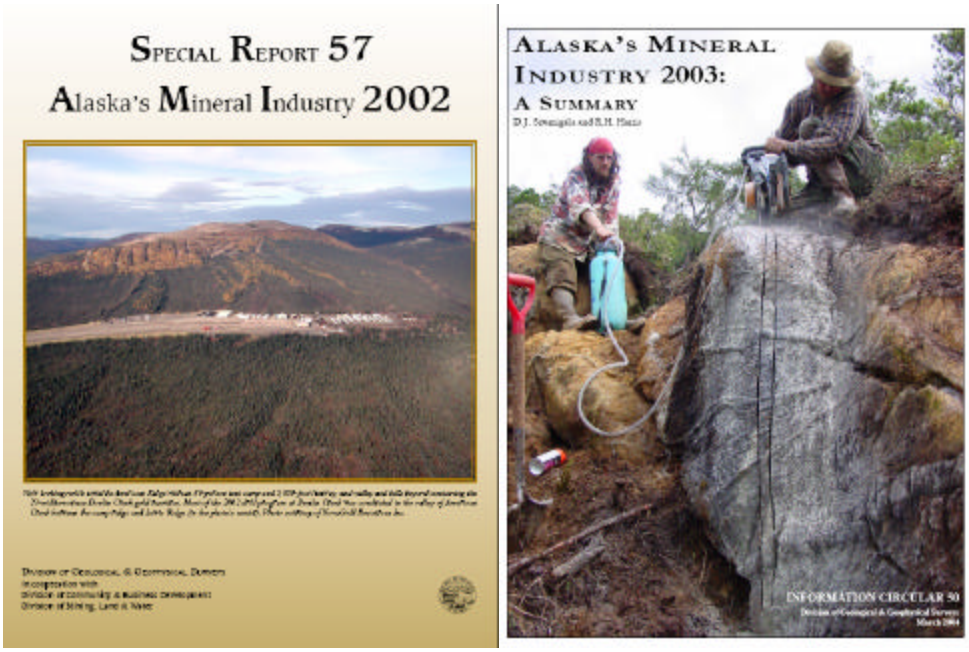
ANNUAL ALASKA MINERAL INDUSTRY REPORT



Alaska Statute 41.08 charges the Division of Geological & Geophysical Surveys *"to determine the potential of Alaska land for production of metals, minerals, fuels, and geothermal resources; the location and supplies of groundwater and construction materials; the potential geologic hazards to buildings, roads, bridges, and other installations and structures; and shall conduct such other surveys and investigations as will advance knowledge of the geology of Alaska."* To meet part of this goal, we gather, verify, collate, and supply statistics and summary observations about Alaska's mineral industry in a timely manner and release this information to the public in the format of an annual mineral industry report, an interim summary, and public presentations. This project assists the mineral industry, provides valuable information to the State in terms of the health of the State's mineral industry, and fosters a better understanding of the significance of the mineral industry to Alaska's private sector and government.

The annual Alaska mineral industry report is a key source of information about Alaska's mineral resource exploration and development. Statewide and international circulation of the annual mineral industry report and its findings at professional mineral industry conventions and trade shows, and in professional journals informs the general public, local and international mineral industry, and local, state, federal, and international government agencies about current activities within the Alaska mineral industry. The report serves as a barometer for the mineral industry's status in any given year and provides unbiased, authoritative information. Government personnel formulating public policy affecting resource and land management rely on the report as an essential asset.

The 2002 Alaska mineral industry report released in November 2003 summarized information provided through replies to questionnaires mailed by DGGS, phone interviews, press releases, and other information sources. The annual report has been published for 22 consecutive years as a cooperative venture between the Department of Natural Resources' (DNR) Division of Geological & Geophysical Surveys and the Division of Community & Business Development (DCBD) in the Department of Community & Economic Development (DCED), with help from the Division of Mining, Land & Water (DMLW) in DNR. The 2003 Alaska mineral industry report will be released by early November 2004.

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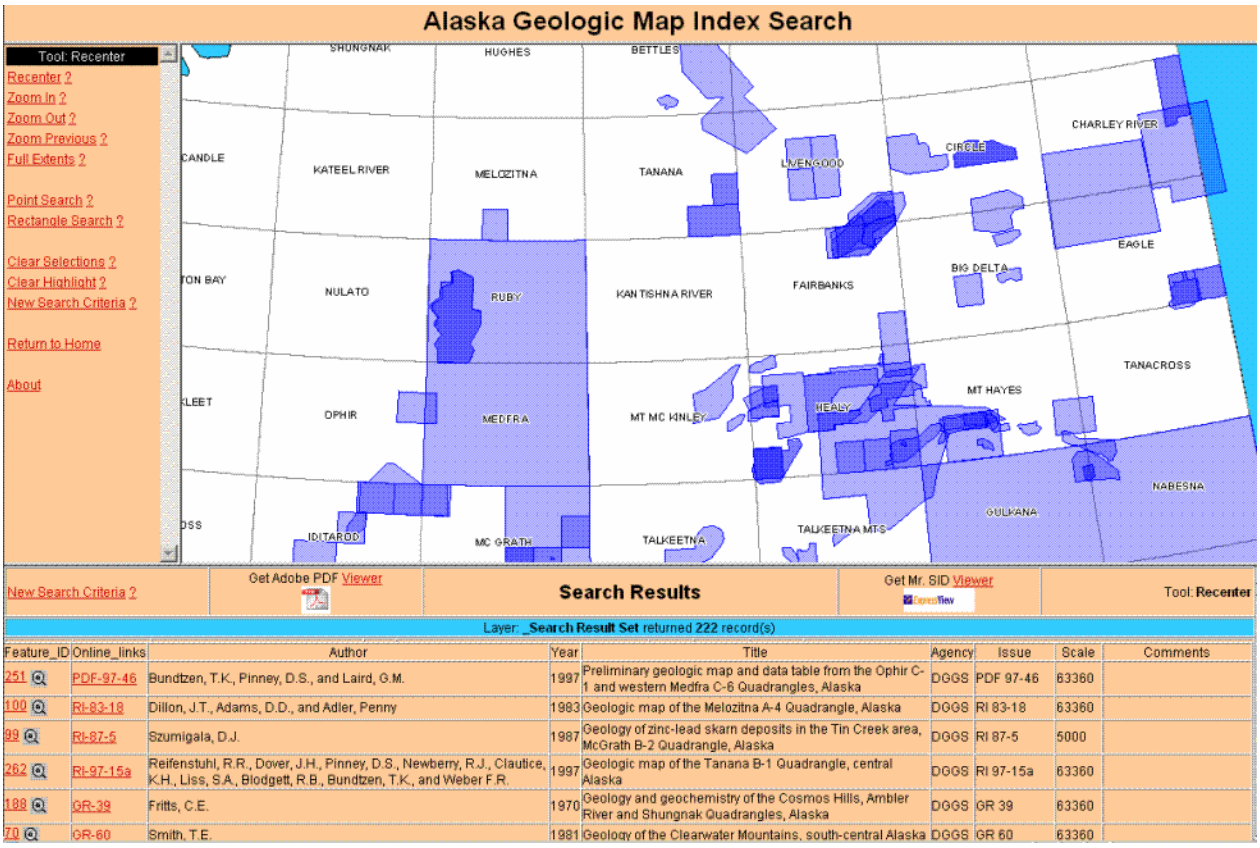
ALASKA BEDROCK AND SURFICIAL MAP INDEX PROJECT



Feature_ID	Online_links	Author	Year	Title	Agency	Issue	Scale	Comments
251	PDF-97-46	Bundtzen, T.K., Pinney, D.S., and Laird, G.M.	1997	Preliminary geologic map and data table from the Ophir C-1 and western Medfra C-6 Quadrangles, Alaska	DGGS	PDF 97-46	63360	
100	RI-83-18	Dillon, J.T., Adams, D.D., and Adler, Penny	1983	Geologic map of the Melozitna A-4 Quadrangle, Alaska	DGGS	RI 83-18	63360	
99	RI-87-5	Szumigala, D.J.	1987	Geology of zinc-lead skarn deposits in the Tin Creek area, McGrath B-2 Quadrangle, Alaska	DGGS	RI 87-5	5000	
262	RI-97-15a	Reifenstuhl, R.R., Dover, J.H., Pinney, D.S., Newberry, R.J., Clautice, K.H., Liss, S.A., Blodgett, R.B., Bundtzen, T.K., and Weber F.R.	1997	Geologic map of the Tanana B-1 Quadrangle, central Alaska	DGGS	RI 97-15a	63360	
188	GR-39	Fritts, C.E.	1970	Geology and geochemistry of the Cosmos Hills, Ambler River and Shungnak Quadrangles, Alaska	DGGS	GR 39	63360	
70	GR-60	Smith, T.E.	1981	Geology of the Clearwater Mountains, south-central Alaska	DGGS	GR 60	63360	

The Alaska Department of Natural Resources, Division of Geological & Geophysical Surveys (DGGS) and Land Records Information Section (LRIS) released the first version of an application that portrays the locations of geologic maps from all government agencies in a single, interactive, Internet-accessible location. The site "Alaska Geology Map Index" <http://maps.akgeology.info/> was made accessible to the public in early November 2003 and currently contains about 300 citations and outlines for DGGS-authored geologic maps. Outlines for about 500 more geologic maps, most of them produced by the U.S. Geological Survey, will be added by DGGS by December 2004.

The purpose of the Alaska Map Index Project is to make the information about the current status of bedrock and surficial geologic mapping of Alaska widely accessible to the mineral industry and others. Currently, an up-to-date index of DGGS, USGS, U.S. Bureau of Land Management (BLM), and U.S. Bureau of Mines (BOM) Alaska geologic maps does not exist. This information will make it easier for the public and government agencies to easily find the geologic maps they need to make informed decisions. The program is part of the federal Minerals Data and Information Rescue in Alaska (MDIRA) program. The primary objective of the MDIRA program is to ensure that all Alaska mineral data are preserved in a safe and readily accessible format for all potential users.

Improvements to the first version of the Web interface will be made by LRIS during FY04. Currently besides allowing searching by rectangle or by point, the interface shown above provides links to scanned reports and maps for each DGGS citation. Subsets of map outlines based on map categories, such as bedrock, surficial, "resources-metals, lode", and "hazards, permafrost" may also be produced by the user through another associated Web page.

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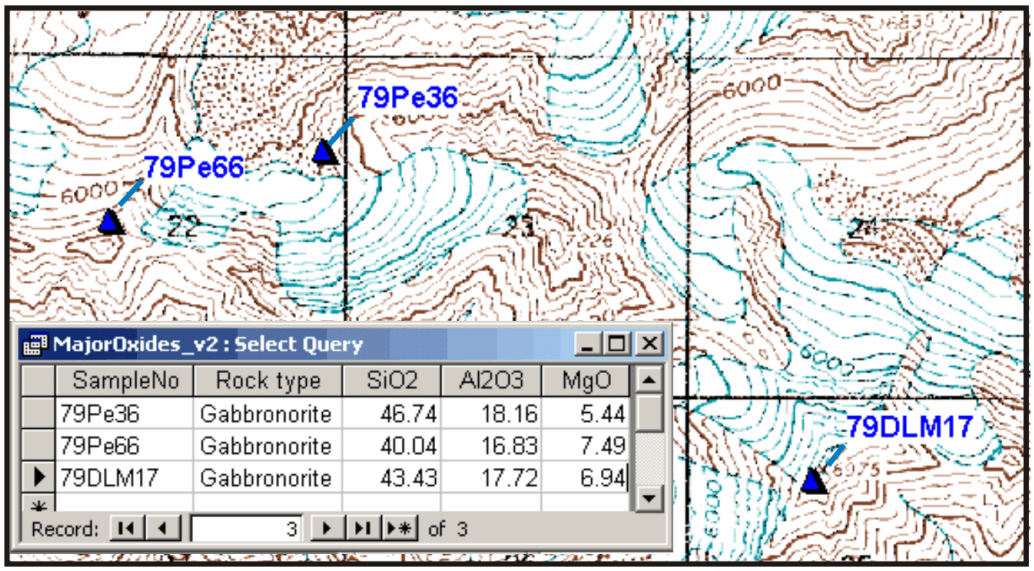
COMPILATION OF ALASKA STATE AGENCY LITHOCHEMICAL DATA



As part of the federally funded Minerals Data and Information Rescue in Alaska (MDIRA) program, all minerals-related Alaska geochemical data sets are to be incorporated in a comprehensive interagency digital geochemical database system. The Minerals Section of the Alaska Division of Geological & Geophysical Surveys (DGGS) is involved in two components of the geochemical program—the Alaska State Agency Lithochemical Data Project (described here) and the Compilation of Existing Resource Assessment Geochemical Datasets Project (described in a separate briefing paper).

The objective of the Alaska State Agency Lithochemical Data Project is to make DGGS lithochemical data accessible via the MDIRA projects Web site <AKgeology.info>. Then the data will be incorporated into the DGGS division-wide database. As part of the MDIRA project, during the past 4 years federal agencies have made a concerted effort to systematically organize their electronic geochemical-data files. That effort is nearly complete for much of the federal quantitative geochemical data. DGGS possesses a significant amount of Alaska mineral-related geochemical data that has not yet been gathered into organized data sets. Some of the data have not been published; other sets are not in digital format and are in danger of being lost. The vast majority of the data have not been digitally linked with geographic locations.

DGGS is assembling the various at-risk lithochemical data that have been generated by DGGS or in some cases generated by the University of Alaska, organizing these data into rational data sets and linking them with georeferenced locations. The DGGS system will be designed and implemented in a manner that is compatible with U.S. Geological Survey PLUTO and RASS data sets and will provide the data for the MDIRA database and Web site. This project works in conjunction with USGS counterparts and the DGGS MDIRA database project. Geochemical data and latitude and longitude sample locations are being compiled in a Microsoft Access database.

We estimate this project will recover 1,200 sets (one sample equals one set) of major oxide analyses, 500 sets of minor element analyses, 3,000 rock trace element data sets, and 500 to 600 mineral compositions data sets. An additional 1,000 major oxide or trace element data sets from unpublished M.Sc. thesis research done at UAF also will be included. Data will be included for the areas of Haines, Lime Peak, Chugach, Fairbanks, Talkeetna Mountains, Interior Alaska, Valdez Creek mining district, and southwestern Alaska, as well as others. The project is scheduled for completion by December 31, 2004.

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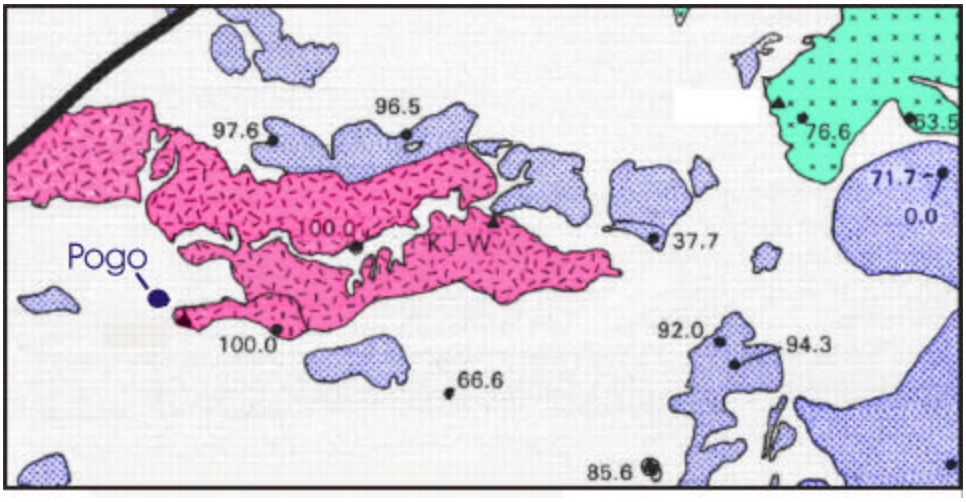
COMPILATION OF EXISTING RESOURCE ASSESSMENT GEOCHEMICAL DATASETS

The objective of the Compilation of Existing Resource Assessment Geochemical Datasets project is to provide three datasets to the public that were compiled by the Alaska Division of Geological & Geophysical Surveys (DGGS) for use in resource assessments. The datasets were designed during investigations of tin granites, plutonic gold ("non-porphyry") systems, and mafic and ultramafic plutonic rocks. These datasets contain about 3,400 analyses of major oxide and trace element analyses and mineral compositions from mineralized and non-mineralized systems around the world. A small percentage of the rocks in these datasets comes from Alaska. Though many of the analyses included in these datasets have been released to the public, they are scattered in hundreds of articles around the world. The data have not been released to the public as a cohesive dataset with a mineral-related purpose. Federal funding, through the Minerals Data and Information Rescue in Alaska (MDIRA) project, will allow DGGS to migrate the data from older computer software to current database standards, document the sources of the data, provide georeferencing for samples where appropriate, and make these refined datasets available to the public.

The datasets can be used to compare compositions between Alaska rocks and those related or non-related to particular ore deposits. The data for the tin-granite and plutonic gold systems were edited so that characteristic compositions of particular types of mineralized and non-mineralized systems could be more accurately identified. These two datasets, consisting of about 1,700 analyses, were used successfully for comparison during evaluation of areas containing potential tin granites and plutonic gold systems (non-porphyry type) in the late 1980s. As an example, "discriminant scores" calculated by multivariate discriminant analysis on the plutonic gold dataset are shown (see figure; modified from Burns and others, 1991). At the time the study was done, this area in Interior Alaska was thought to be barren of gold deposits. The scores indicate degree of similarity of the rock analyzed to plutonic rocks associated with systems that produced gold deposits. Scores in the diagram range from about 63 (considered to indicate very low similarity) to 100 (considered indistinguishable from plutons associated with gold systems). The discriminant scores of '100' near the later-discovered Pogo deposit were an indication that gold-related plutonic systems may well be present in the area. The particular plutonic rock associated with deposition of gold at Pogo is not exposed at the surface. The predictions DGGS made based on the plutonic gold dataset were thought to be a major catalyst of much mineral exploration in this part of the interior in the early 1990s.



The third dataset includes about 1,750 rock and mineral analyses from mafic and ultramafic bodies and shows interesting trends between the different types of ultramafic and mafic rocks. This dataset may also eventually be used as an aid for locating platinum-group-element mineralization.

The datasets will be released via the DGGS and MDIRA Web sites (<www.dggs.dnr.state.ak.us> and <www.akgeology.info>, respectively). The project should be completed by the end of 2004.

Burns, L.E., Newberry, R.J., and Solie, D.N., 1991, Quartz normative plutonic rocks of interior Alaska and their favorability for association with gold: Alaska Division of Geological & Geophysical Surveys Report of Investigation 91-03, 71 p., scale 1:412,500; 2 sheets.

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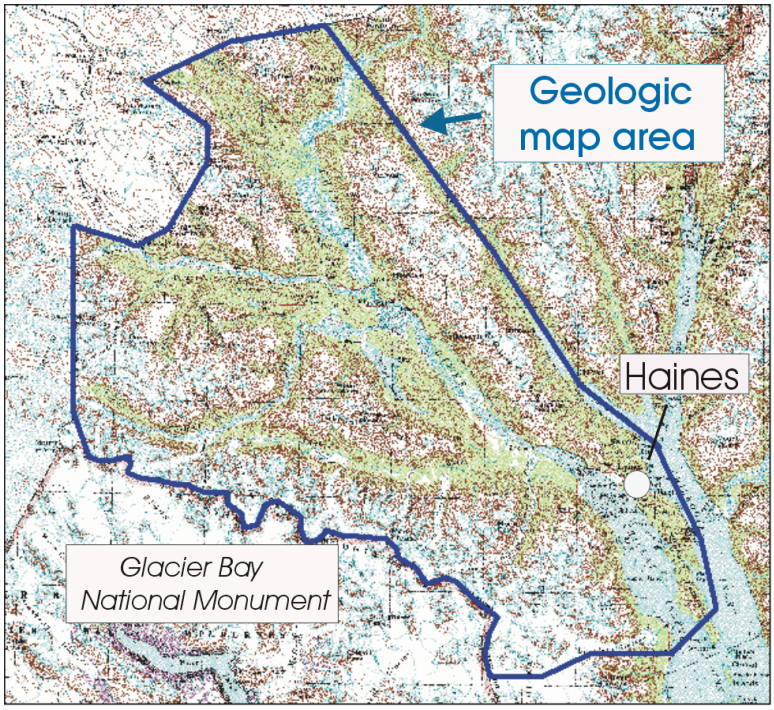
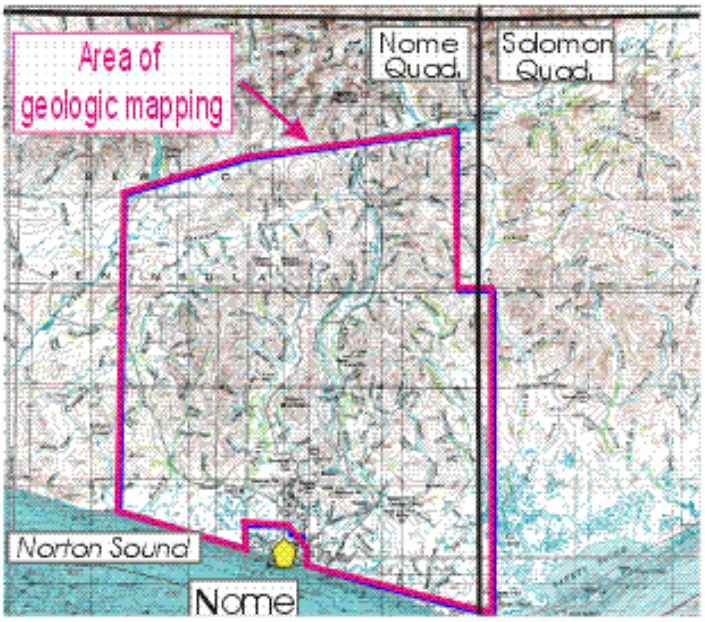
GEOLOGIC MAPS OF THE HAINES AND NOME AREAS



As part of the Minerals Data and Information Rescue in Alaska (MDIRA) project, as many minerals-related Alaska geologic maps as possible will be incorporated in a comprehensive DGGS geologic database system. This 'Geologic Maps of the Haines and Nome areas' project will publish two bedrock geologic maps, for which DGGS has completed field work and draft maps but which have not been published, and incorporate them in the division-wide database. The maps include a 900-sq-mile geologic map of the Haines area and a 250-sq-mile geologic map of a highly prospective mineralized tract near Nome on the Seward Peninsula (see figures). The maps will be published in hard copy format and placed on the DGGS Web site.

The Haines map covers the entire Porcupine mining district. This bedrock and surficial geologic map has been reviewed and edited as a Professional Report. The map unifies five geologic maps previously published in reconnaissance form for a 900-sq-mile area. The authors of the five geologic maps used different nomenclature and mapping styles. The map to be published contains the synthesis of terminology and map units that were worked out by the original authors. The second sheet of the Haines map contains sample locations, radiometric ages, and geochemical data. Production of the Haines map was interrupted near completion. This area is a major section of southeastern Alaska that has no existing coherent geologic map. This project will complete the digitizing of the geologic map and cross-sections and publish the map both in hard copy form and on the DGGS Web site. The Haines map project will begin in winter of 2004 and is scheduled to be finished by end of August 2004.



The Nome map covers a portion of the Nome mining district. An initial year's worth of geologic mapping was released for part of the area, but compiling the mapping of a second summer of geologic work was delayed due to other State priorities. This project will compile the field data and publish the geologic map. The Nome map project will begin in summer 2004 and is scheduled to be finished by the end of FY05.

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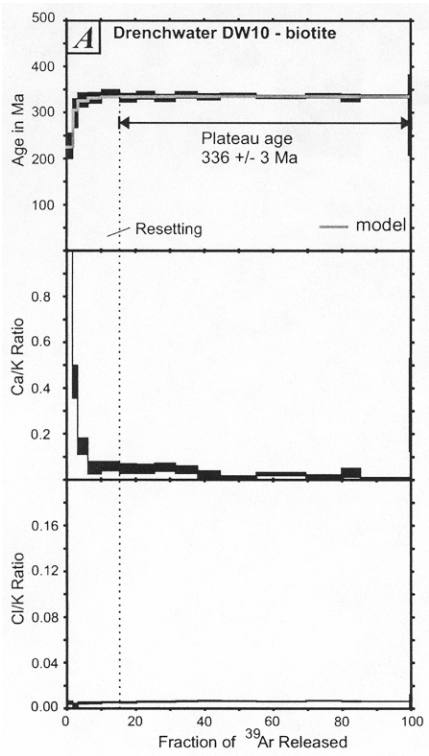
GEOCHRONOLOGIC DATABASE FOR ALASKA



In January 2004 the Alaska Division of Geological & Geophysical Surveys (DGGS) will begin creating a geochronologic database that will contain age data and associated information for all available radiometric dates for rocks and minerals in Alaska. The objective of this project is to expand the most-current existing compilations of radiometric data and to make this age information widely accessible to private industry, academia, and government. This project is part of the federally funded Minerals Data and Information Rescue in Alaska (MDIRA) program. The primary objective of the MDIRA program is to ensure that all Alaska mineral data are preserved in a safe and readily accessible format for all potential users. Information on mineral resources is important for encouraging private investment in minerals exploration and for management policy decisions in both the public and private sectors. Higher quality data should lead to better economic, legislative, and environmental decisions.

DGGS's existing Oracle-based relational database structure will be used as a starting point for the structure of the geochronologic database. Additional fields will be added after consulting laboratory analysts and other geologists with a vested interested in using the database. The database will include dates for all available U/Pb, K–Ar, $^{40}Ar/^{39}Ar$, and Rb/Sr data for Alaska. The initial source of age data will be the previous compilations by Wilson and others (1990; 1999). Additional radiometric dates will be compiled from both published and unpublished sources. In addition to updating the existing compilation, this database project will add essential basic supporting information that is currently not easily accessible. This information includes items such as raw analytical data, standards, constants used in calculations, analytical laboratory, analyst, sample preparation and processing steps, sampling agency and geologist, and sample context and descriptions where the data are available. Much of the supporting data are present in the original publications for the age data, including unpublished student theses, or are archived in laboratory or industry files. Where data are not available in published form, letters requesting more information will be sent to appropriate geologists, requesting that they provide the data (if they have it) or, more likely, that they will give permission for the laboratory to provide the information. GeoRef and a dataset currently under construction at DGGS, the Bedrock and Surficial Geologic Map Index, will be used to search for additional sources of data.

This geochronologic database will provide a centralized, up-to-date, digital source of radiometric dates. Addition of the basic supporting data, where possible, will allow the geoscience community to critically evaluate the validity of these ages and to make their own interpretations. The final stage of the geochronology project will be to make this database accessible via DGGS's Web site and through a link on the Alaska Minerals Data & Information Web site <www.akgeology.info>. Bibliographic citations for DGGS and U.S. Geological Survey publications will be linked to digital or PDF files of the appropriate publication. The geochronologic database project is scheduled to be completed in two years. The completed database will reside in DGGS's Oracle database, which will serve as a repository for future radiometric data.

Wilson, F.H., Shew, Nora, and Dubois, G.D., 1990, Map and table showing isotopic age data in Alaska, in *Plafker, G. and Berg, H.C., eds., Geology of North America, The Geology of Alaska, Vol. G-1, Plate 8.*

Wilson, F.H., Shew, Nora, Dubois, G.D., and Dadisman, Shawn, 1999, Alaska Radiometric Ages: U.S. Geological Survey, <http://minerals.usgs.gov/sddp/mrdata/sddpftp.shtml>.

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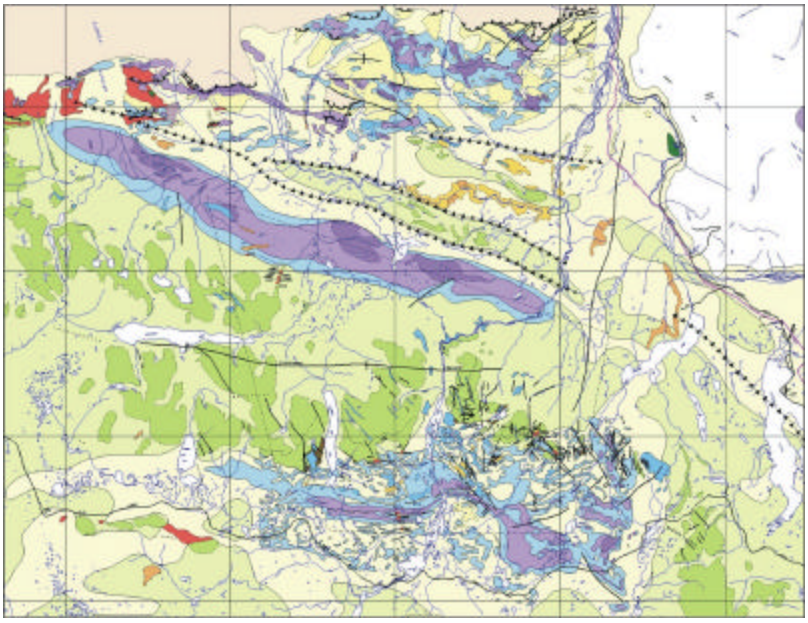
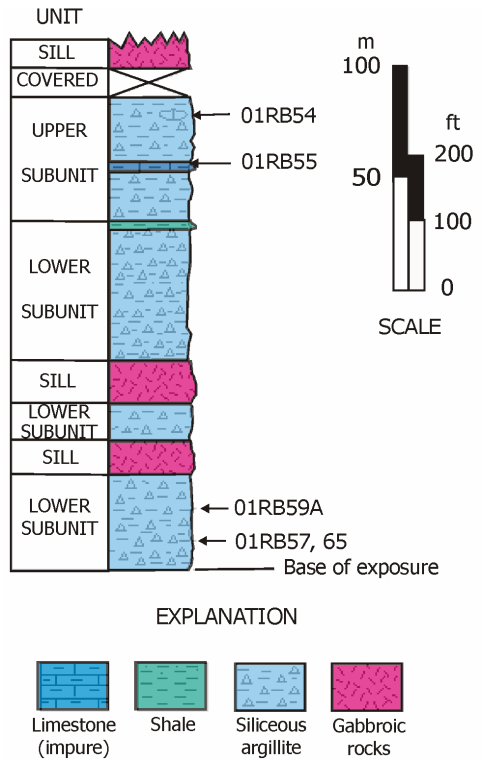
GEOLOGY OF THE AMPHITHEATRE MOUNTAINS, SOUTHCENTRAL ALASKA

DGGS entered into a cooperative project with the Geological Survey of Canada (GSC) to investigate mineral potential of ultramafic rocks in the southern Delta River region near Paxson in spring 2000. The objective of the project is to better understand and disseminate knowledge about regional metallogeny and Triassic magmatism in Wrangellia. Within the last 10 years, a metallogenic terrane of mafic and ultramafic rocks favorable for deposits of Ni–Cu–PGE, +/-Au has been identified to extend about 600 km along strike on the margin of "Wrangellia" from northern British Columbia into Alaska south of the Denali fault. One of the best exposures of this terrane is present in the Broxson Gulch area in the Amphitheatre Mountains, about 180 miles north of Valdez. The ultramafic rocks form sill-like intrusive centers thought to have acted as subvolcanic magma chambers that fed the thick, overlying basalts of the Nikolai Group.



As part of our participation in the project, DGGS contracted a paleontologist who investigated and summarized fossils below the ultramafic rocks. This report was published by DGGS in spring 2002 (R.B. Blodgett, Report of Investigations 2002-3). The final product of this project will be a geologic map of the area authored by GSC and published by DGGS. The final geologic map will be provided by GSC at the end of FY04 for publication by DGGS in FY05.



This area has been of much interest to the mining community in the last several years because of the potential for platinum-group-element (PGE) metal deposits. BLM and DGGS conducted and released a BLM-funded airborne geophysical survey (known as the southern Delta River survey) over the area in 2003. The geology of the area is, however, very poorly known.

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BEDROCK GEOLOGIC MAP OF THE DELTA MINERAL BELT TOK MINING DISTRICT, ALASKA

Professional Report 122, *Bedrock Geologic Map of the Delta Mineral Belt*, focuses on the geology of a 400-square-mile area in the eastern Alaska Range. The publication presents a progress report of the understanding of the geology related to the formation and distribution of volcanic-related massive-sulfide deposits in the eastern Alaska Range from information gained by private industry during the previous 25 years. The publication, authored by private industry and published by DGGS, represents a unique effort to release a large amount of privately owned geologic data to the public. This will preserve the mineral deposit information for the future.

The Delta mineral belt has been the subject of intense geologic investigation since volcanogenic massive-sulfide occurrences were found there in 1976. Approximately $20 million was spent by private industry (1976–2001) exploring for and evaluating base-metal and gold deposits in the Delta mineral belt. Exploration work has included detailed- and reconnaissance-scale geologic mapping; chemical analysis of approximately 30,000 rock, soil, drill core, stream sediment, and pan concentrate samples; ground and airborne geophysical surveys; and about 35 miles of core drilling in over 186 holes. That work resulted in the discovery of more than 40 massive-sulfide occurrences and more than a dozen gold prospects, and created a library of proprietary geologic data and information. A synopsis of those data is assembled in this report for presentation at the scale 1:63,360 (1 inch = 1 mile). The report summarizes the regional, local, and economic geology; discusses lithochemistry and protolith interpretations; presents results from recent $^{40}Ar/^{39}Ar$ and U–Pb dating; and provides major oxide and trace element chemical analyses for 827 rock samples collected from across the map area.

Because of the geologic work, more than 40 mineral occurrences have been discovered at Delta. An inferred resource has been calculated for eight of these deposits. Geologic mapping and study of the drill core led to a detailed stratigraphy of the area. The stratigraphy suggests that massive-sulfide mineralization occurs in at least four stratigraphic levels. Information contained in this summary work may apply to other massive-sulfide occurrences in eastern Alaska as well.

The report and map published through this project were authored by Northern Associates, Inc. (NAI) and were based on the geologic mapping, lithochemistry, airborne geophysics and core drilling carried out under the supervision of NAI personnel during 1994–1999 for American Copper and Nickel Co. (ACNC) and Grayd Resources. Work by previous companies, such as Resource Associates of Alaska, was used as an initial framework by ACNC. The publication was released in its final form in early November 2003.

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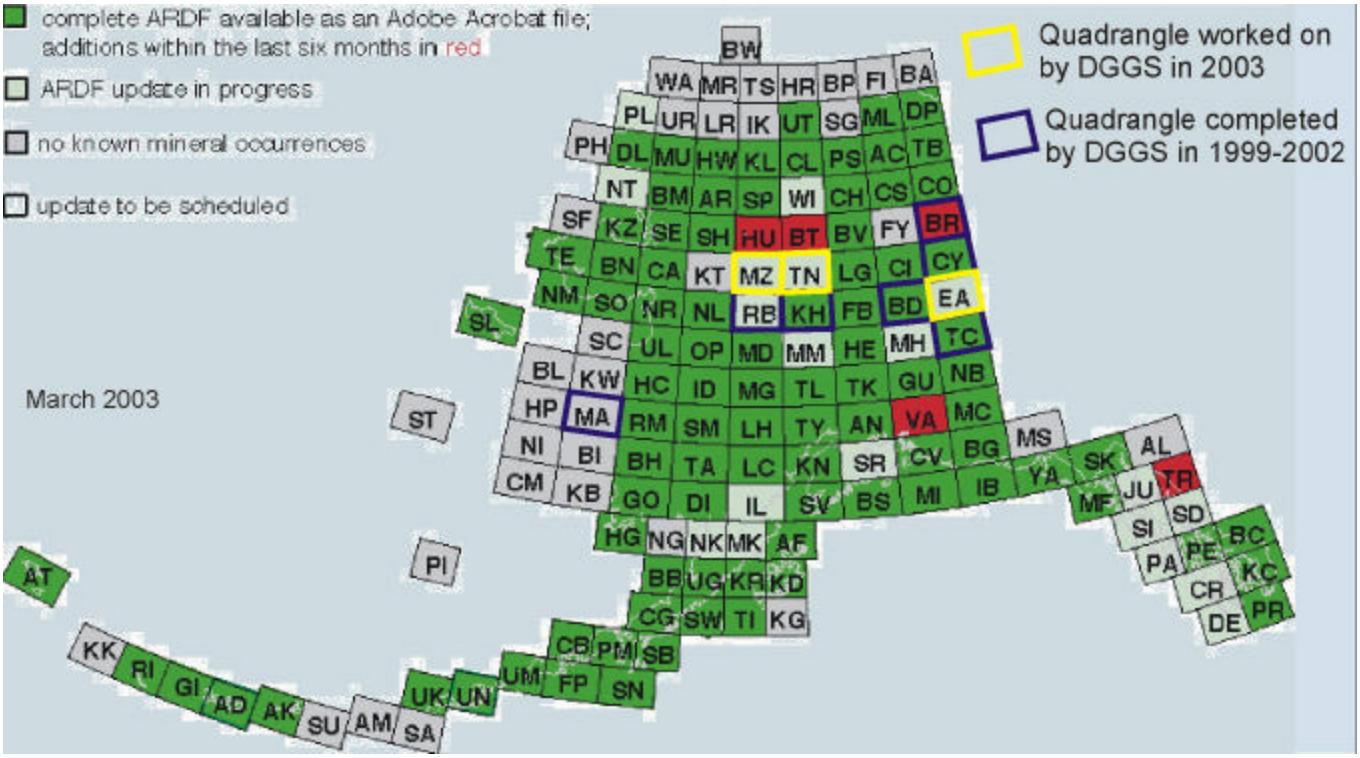
ALASKA RESOURCE DATA FILE PROJECT
(ALASKA MINERAL DEPOSIT DATABASE)



DGGS has been compiling information on mineral deposits, prospects, and occurrences under a cooperative agreement with the U.S. Geological Survey (USGS) as part of the Federal Minerals Data and Information Rescue in Alaska (MDIRA) program. The primary objective of the Data and Information Rescue project is to ensure that all Alaska mineral data are preserved in a safe and readily accessible format for all potential users. Information on mineral resources is important for encouraging private investment in minerals exploration and for management policy decisions in both the public and private sectors. Higher quality, accessible data leads to better economic, legislative, and environmental decisions. One component of this program is a digital (electronic) database of mineral deposits of Alaska known as the Alaska Resource Data Files (ARDF). These files are the first comprehensive update of Alaska's mineral deposit database in a quarter century.

Descriptions of mines, prospects, and mineral occurrences in the Alaska Resource Data Files are compiled for individual USGS 1:250,000-scale quadrangles in Alaska (see map) as USGS Open-File Reports and are available for downloading from the USGS Web site <http://ardf.wr.usgs.gov/>. Descriptions in the ARDF database are derived from published literature, state mining claim files, state land status information, personal interviews, and unpublished reports and data from various sources including DGGS, the U.S. Bureau of Land Management, the USGS, Alaska Native corporations, and the mineral industry. The records in the database are generally for metallic mineral commodities only but occasionally may include certain high-value industrial minerals such as barite and rare-earth elements. Common industrial minerals such as sand and gravel, crushed stone, and limestone, and energy minerals such as peat, coal, oil, and gas are not included in this database. As of November 2003, 4,779 records (1,422 placer, 3,357 lode) were included in this database for 99 of 153 Alaska quadrangles.

DGGS will complete nine quadrangle mineral deposit record-sets that meet peer review and USGS ARDF staff review criteria. DGGS minerals section staff have already completed ARDF files for the Big Delta, Black River, Tanacross, Kantishna River, Charley River, Eagle, and Ruby quadrangles. A literature review by DGGS for mineral deposits in the Marshall Quadrangle did not find any known mineral occurrences. In FY04, final review comments will be addressed for the Tanana and Melozitna quadrangles, and will conclude our part of this phase of the ARDF project.

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TRANSPORTATION CORRIDOR MAP CONVERSION

Access to Alaska's mineral lands is a strategic issue for the State and Federal governments, and for the resource industries. During previous campaigns undertaken by the State of Alaska to select statehood entitlement lands, many potential access corridors were identified and linked in a conceptual long-range transportation grid (fig. 1). In 1992, the DGGS Corridor Evaluation Project produced a series of 376 digital geologic, geologic-materials, geologic-hazards, and data-quality maps in 78 quadrangles at 1:250,000 scale for these transportation corridors. These maps were important tools in the selection of State lands, and have continued to be requested by companies and agencies in the decade since their compilation. By 1999, it became clear that the digital plot files for these maps had become unusable because they were made for plotter technologies and software versions that were no longer supported (fig. 2). Thus, these maps were no longer available to policy makers, mineral explorationists, and engineers who have need of the information that they portray.

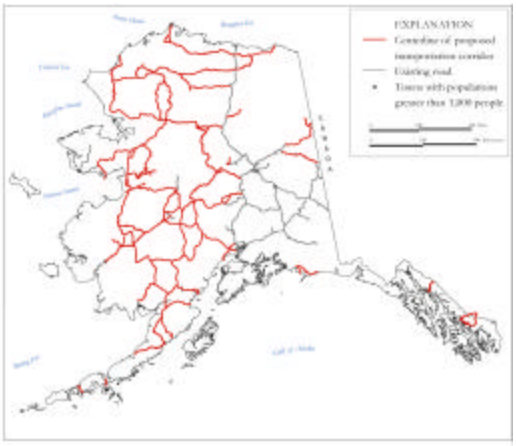

Figure 1. Map showing proposed transportation corridors (red lines) for which geologic information was compiled during the 1992 Corridor Evaluation Project.

With Federal funding from the Minerals Data and Information Rescue in Alaska (MDIRA) program, DGGS is converting the data for the statewide transportation corridor network map suite from their obsolete digital format to the most current Arc 8.x export format in order to formally publish the maps with topographic bases (fig. 3) and an accompanying explanatory report. Hardcopy maps will be available in January 2004. By July 2004 the maps and data will be downloadable from the World Wide Web in MrSID and georeferenced MrSID format, and will also be available as Arc export files.

As interest in expanding Alaska's transportation network increases, so too will the need for baseline engineering-geologic data. This project will give mineral explorationists, transportation engineers, and policy makers valuable tools to better assess future transportation issues by providing them with critical geologic information that can affect decisions about transportation options for enterprises ranging from mineral development and land access to siting structures and identifying potential source areas for construction materials.

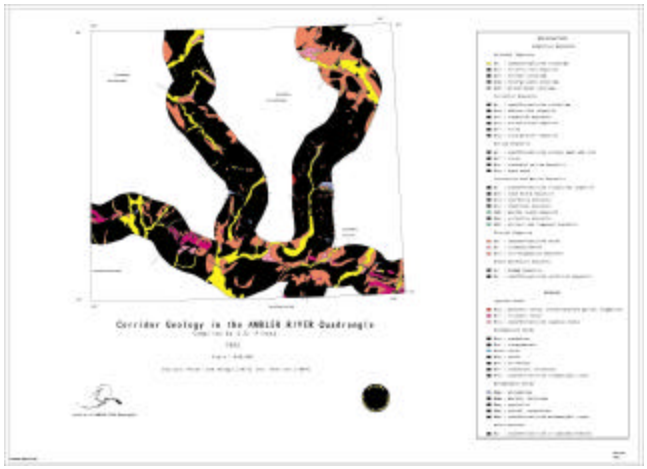

Figure 2. Corridor geologic map generated from old files. Map shows unacceptable colors due to obsolete data coding, very rudimentary cartographic layout, and lack of topographic base.

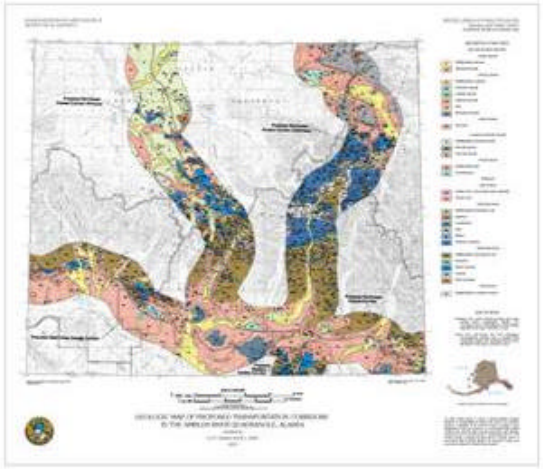

Figure 3. New corridor geologic map for the same quad-rangle. Map shows updated color coding and symbology, and revised cartographic layout with topographic base.

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CREATING LOCAL EMPLOYMENT OPPORTUNITIES IN THE RURAL NATIVE COMMUNITIES OF NORTHWESTERN ALASKA

Historically, small-scale placer-gold mines have been highly successful as a means of generating income in rural areas. Between 1992 and 2001, however, 780 of a total 1,251 placer mining jobs had been lost statewide. Most of these jobs were located in rural Alaska and provided well paying seasonal employment to local residents. In an effort to help facilitate the economic viability of rural communities through increased placer mining opportunities, DGGS is in the second year of a 2-year NASA-funded project to apply remote sensing imagery, high-resolution Digital Elevation Models (DEMs) (fig. 1), and high-altitude color-infrared photography in conjunction with knowledge of geomorphology, surficial deposits, and bedrock geology, to evaluate the placer gold potential of part of the Council placer mining district on the Seward Peninsula, northwestern Alaska.

Figure 1. Interferometric SAR-derived DEM of the Council area.

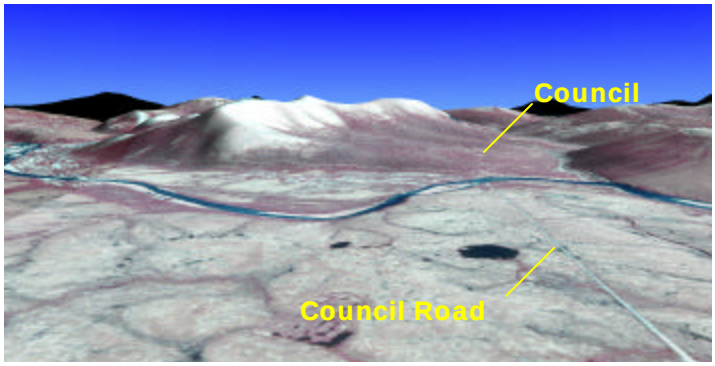

Figure 2. Color-infrared airphoto mosaic draped over inSAR-derived DEM. Virtual three-dimensional landform models such as this are being investigated for use in evaluating the placer potential near Council.

The final products from this project, expected in June 2004, will consist of detailed geologic maps of unconsolidated Quaternary sedimentary deposits, appropriate cross-sections, and three-dimensional landform models (fig. 2). The maps and models will display the spatial relationships between deposits that are fundamental to understanding the Quaternary geologic history of the mining district and to identifying the most probable location and extent of currently undiscovered placer gold-bearing paleochannels. All map products will be produced in conformance with NGDC standards and will be in ESRI ArcGIS format.

As part of our commitment to the rural residents of the Seward Peninsula, DGGS is also presenting a series of educational workshops in Nome (fig. 3) for the purpose of teaching interested members of the communities impacted by this research how to understand, interpret, and apply the products being generated by the study.

Figure 3. The second season of the DGGS educational workshop program in Nome attracted members of local government, teachers, and the general public. Topics included satellite imagery, aerial photographs, geology, topographic maps, GPS, and GIS, and involved hands-on field exercises in the Nome area.

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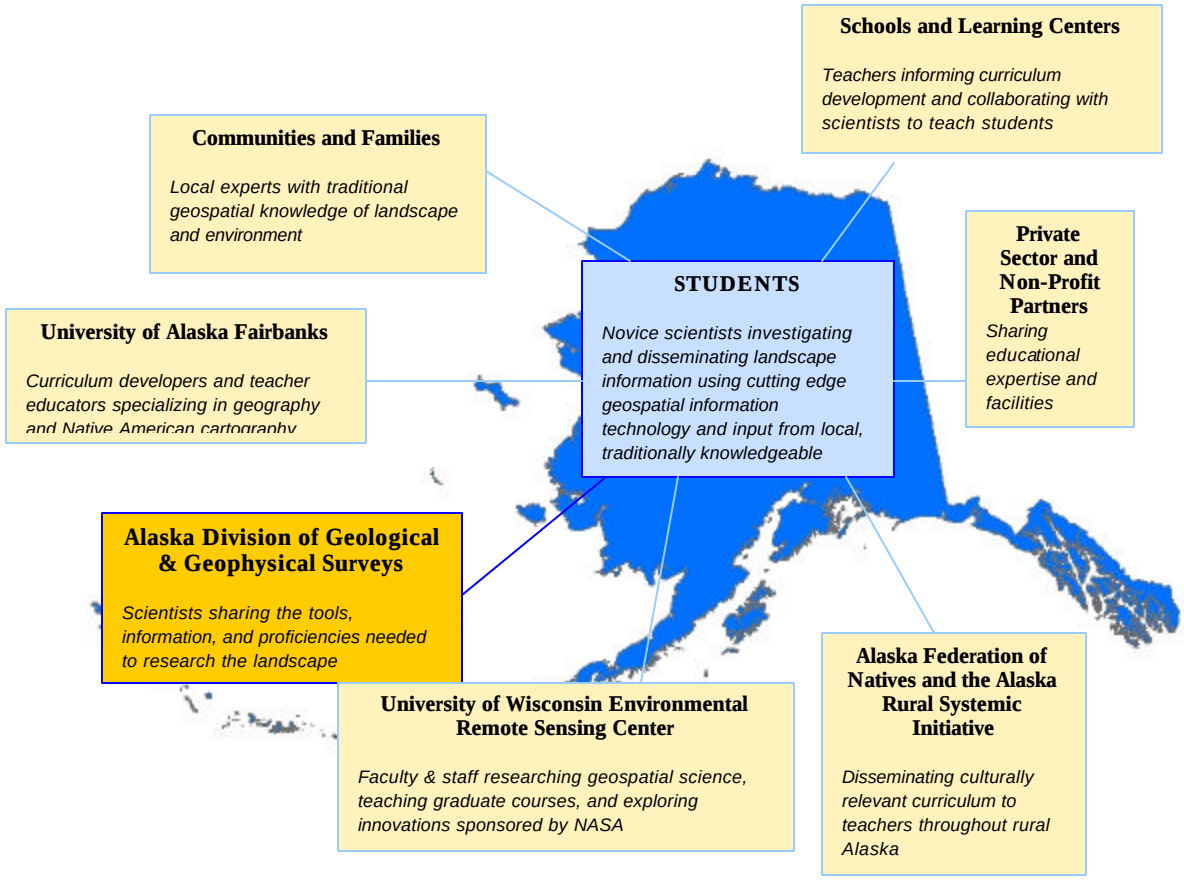
FIELD-GEOSCIENCE OUTREACH AND EDUCATION IN RURAL ALASKA

With the participation of 10 partner organizations (including private-sector, non-profit, and educational institutions), DGGS is beginning work on a 3-year NSF-funded collaborative project with the University of Wisconsin Environmental Remote Sensing Center and the University of Alaska Fairbanks Geography Department to develop a field-geoscience outreach program for middle- and high-school students in rural Alaska. This program will emphasize hands-on experience with spatial technology (GPS, GIS, and remote-sensing imagery in a local landscape–landform context) in conjunction with traditional activities (see figure), and will be piloted in the Minto, Nenana, Nome, and Fairbanks areas. Since participants will work directly with DGGS geologists, they will be presented with a chance to authentically emulate scientific activities at a novice level, using real data in a real-world setting. Concurrently, DGGS will learn to incorporate education and outreach into its geological practices when working in rural Alaska communities. During 2003, the first year of the project, DGGS will provide initial data sets for field kits, including GIS data layers of geology, satellite and aerial remote-sensing images, and begin work on area-specific field guides ('Trail Guides') that will allow students to locate examples of important geological features in their local area. DGGS will also provide geologic and geospatial expertise in the development of the curriculum.

The program will be implemented in two separate but content-equivalent formats to meet the unique requirements of accessing students in rural Alaska. Students serviced by centralized school districts will take part in a nine-week (standard school quarter), after-school, classroom-based curriculum that will culminate in a 7-day summer Capstone Field Experience during which students and teachers will interact in a field camp setting with Native Elders, traditions-based community leaders, and professional geologists from DGGS. Other, more geographically-dispersed students will be brought together in Intensive Studies Institutes at established living-learning facilities for two weeks of full-time classroom instruction, followed by a 7-day Capstone Field Experience. Introducing students, their families, and their communities to geoscience and geospatial technology in a stimulating field setting will enhance public understanding of the role of natural resources in developing viable economies for rural Alaska and foster buy-in to informed management practices.



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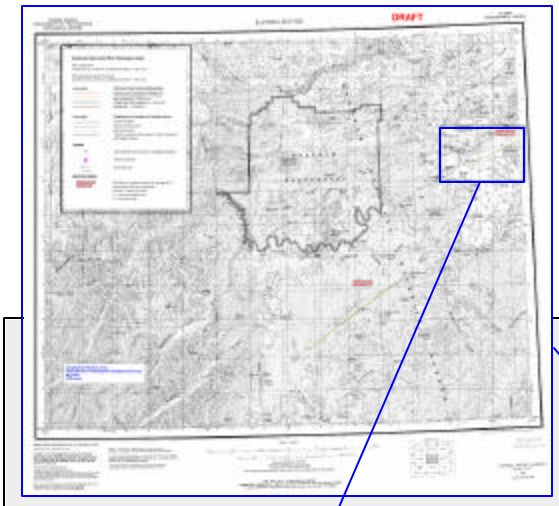
MAPS AND DATABASE OF QUATERNARY FAULTS AND FOLDS

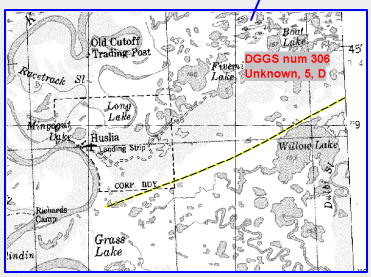
The U.S. Geological Survey (USGS) initiated a cooperative project with DGGS to compile data on active faults and folds in Alaska in GIS and text formats. With funding provided by USGS, DGGS conducted an extensive literature survey to summarize published information on faults and folds that show geologic or seismic evidence of activity during the Quaternary period. In addition, DGGS is digitizing the fault traces and fold axes at 1:250,000 scale and recording associated attribute data in a GIS database. The resulting report and maps will facilitate evaluation of faulting and earthquake hazards for future development projects in the state.

A comprehensive literature search for pertinent published materials on Quaternary faults and folds in Alaska has been completed. Remaining tasks include: completion of text-based descriptions of faults and folds using a nationally established format, compilation of fault traces and fold axes in GIS with associated attributes according to national guidelines. DGGS submitted text files and the compiled map data to USGS at the end of FY03.

Work on this project was on hold for over a year because of other priorities, such as responding to the magnitude 7.9 Denali Fault earthquake. The Denali Fault earthquake generated significant interest in the Quaternary fault compilation and a desire to complete the work as soon as possible. USGS and DGGS are currently determining the most efficient way to complete the project. Once available in a published format, this compilation will be useful to municipal and emergency planners, engineers, and researchers.



Draft map of Quaternary faults: Kateel River Quadrangle, Alaska



Huslia fault, Kateel River Quadrangle, Alaska

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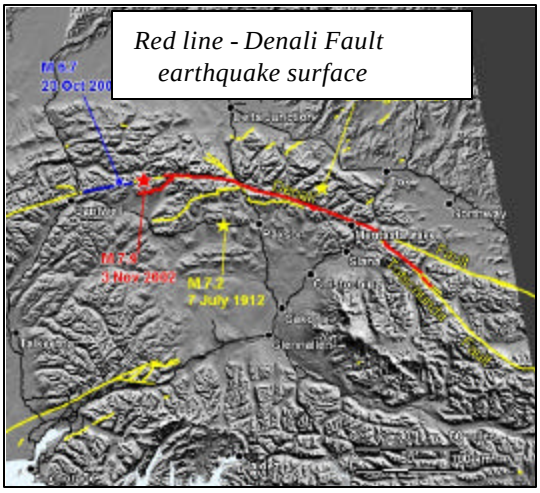
DENALI FAULT EARTHQUAKE RESPONSE

DGGS continues to respond to the November 3, 2002, magnitude 7.9 Denali Fault earthquake on several levels including field research, public and professional outreach, and cooperation with various emergency and regulatory agencies.



DGGS responded to the Denali Fault earthquake by deploying a field geologist to evaluate the fault rupture within 24 hours of the event. Reconnaissance efforts revealed that the earthquake caused a total of 340 km of surface rupture affecting three separate faults in central Alaska—the Denali and Totschunda faults, and the newly discovered Susitna Glacier fault.

Geologists Patty Craw (DGGS) and Peter Haeussler (USGS) measure fault offset on glacier ice.

DGGS continues to conduct field research on the rupture with financial support from the U.S. Geological Survey. Goals of current research on the fault include: (1) understanding the behavior of the Denali Fault—how often and where the fault ruptures the earth's surface, how large earthquakes on the fault can be, and how the 11/3/02 event affected stress on the unruptured ends of the fault, and (2) understanding the relationship between the Denali fault and other potentially active faults in the Alaska Range. Currently DGGS's primary involvement in the field effort focuses on the Susitna Glacier thrust fault, which is where the surface rupture initiated during the earthquake. Research efforts have resulted in publications in various scientific journals and magazines including *Science* and *Science News*. Future publications will include a *Bulletin of the Seismological Society* special issue regarding the Denali Fault earthquake as well as USGS maps and reports.

DGGS involvement in outreach efforts resulting from the Denali Fault earthquake includes meeting with earthquake victims in the Copper River Basin, presenting information to K–12 and university students, conducting public-interest lectures, presenting findings at professional meetings, and an appearance on Alaska Public Radio's statewide call-in show, *Talk of Alaska.*

Patty Craw meets with earthquake victims in the Copper River Basin.

Patty Craw at the KUAC public radio studio in Fairbanks.

Although the Denali Fault earthquake did not cause oil to spill from the Trans-Alaska Pipeline, infrastructure was damaged as a result of ground movement during the event. DGGS is working with Alyeska Pipeline Service Company, its contractors, and Joint Pipeline Office officials to determine where future research regarding the Denali and other potentially active faults in the Alaska Range is relevant to retrofit and continued safe operations of the pipeline.

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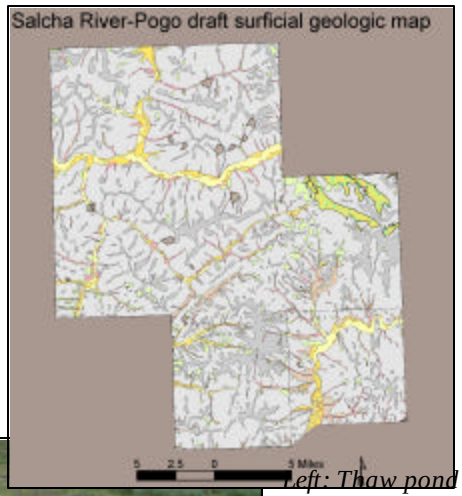
SURFICIAL AND ENGINEERING GEOLOGIC MAPPING

The DGGS Engineering Geology Section is currently involved in three surficial-geologic mapping projects supported in part by the U.S. Geological Survey (USGS) STATEMAP program. The DGGS Minerals Section leads the Salcha River–Pogo and Livengood projects; the DGGS Energy Section leads the Kanayut River project.



We are in the process completing 1:63,360-scale surficial, engineering, and comprehensive maps for the Salcha River–Pogo area (Big Delta C3, SW¼ of the Big Delta C2, and NE¼ of the Big Delta B3 and most of the NW¼ of the Big Delta B2 quadrangles). These maps describe surficial deposits and related geologic hazards. Deglaciation, periglacial processes, and mass movement combine to create an unstable geologic environment at high elevations in the study area. Avalanche cones, debris-flow deposits, rubble sheets, steep colluvial aprons, and active thaw lakes indicate unstable conditions. Avalanches responsible for cone development are capable of moving and depositing boulders exceeding 2 meters in diameter. Debris flow deposits occasionally extend into valley bottoms and are common in glacial cirques.

Left: Thaw pond on probable Salcha age glacial deposits, Lower Boulder Creek, Salcha River–Pogo area.

Abov: Aerial view to the south up Erratic Creek, east of Kanayut River.

DGGS geologist Patty Craw and University of Arizona geologist Robert Casavant conducted 2 weeks of surficial geologic fieldwork for the Kanayut River mapping project during the summer of 2003. The surficial-geologic map will refine earlier 1:250,000-scale mapping by Tom Hamilton (USGS). An engineering-geologic map will be derived from the 1:63,360-scale surficial and bedrock geologic maps.

Right: Early Itkillik age glacial erratic on slope adjacent to Erratic Creek. Near photo location above.

DGGS geologists Patty Craw and Carrie Browne and DGGS student intern Lauren Staft conducted 10 days of field work in the Livengood area during the summer of 2003. Florence Weber (USGS emeritus geologist) and Takashi Sakurai (UAF Oral History Department) accompanied geologists Patty Craw and De Anne Stevens (DGGS) for one day of field work in October 2003. The primary objective of the October fieldwork was verification and refinement of work conducted by the summer field team. The field effort will result in 1:63,360-scale surficial, engineering and comprehensive geologic maps to be completed by spring 2004. In addition, Takashi Sakurai collected 3 hours of audio documentation and about 2 hours of video documentation focusing on Florence Weber's life and decades of work as a pioneering Alaskan geologist. Mr. Sakurai's documentation is located in the UAF oral history archives.

Carrie Browne and Lauren Staft (DGGS) dig a soil test pit in the Livengood area.

Above: Patty Craw (DGGS) and Florence Weber (USGS) observe lithologies associated with a debris-flow deposit in the Livengood area. Takashi Sakurai (UAF) documents the geologists at work

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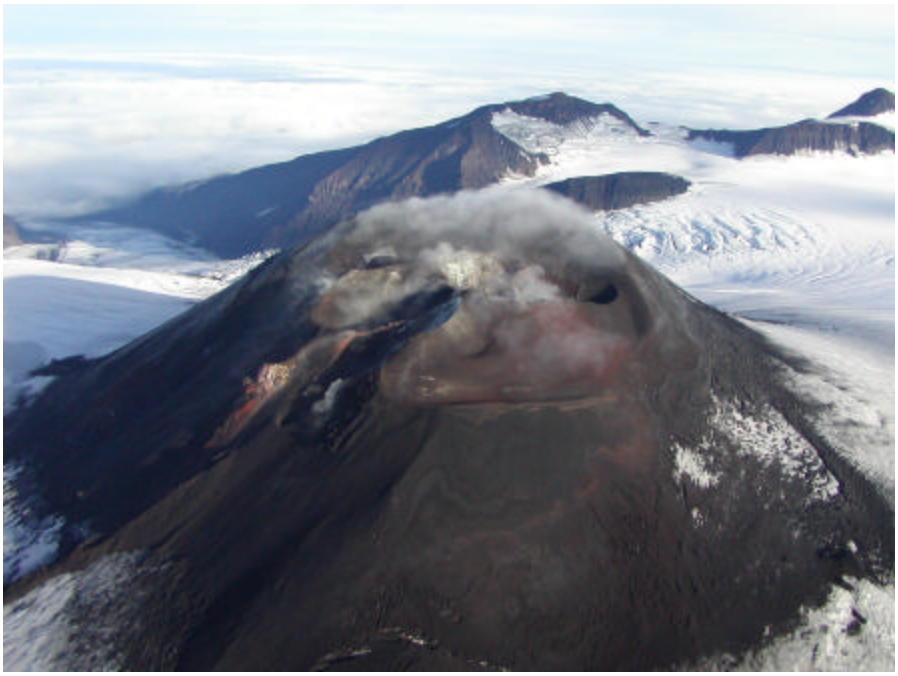
ALASKA VOLCANO OBSERVATORY

The Alaska Volcano Observatory (AVO) is a multi-agency program that uses State, Federal, and university resources to monitor and study Alaska's hazardous volcanoes, predict and record eruptive activity, and implement public safety measures. AVO is a cooperative program of the Alaska Division of Geological & Geophysical Surveys, the U.S. Geological Survey, and the University of Alaska Fairbanks Geophysical Institute.



The active intracaldera cone at Veniaminof Volcano. Photo by Chris Nye, AVO/ADGGS, August 2001. On December 21-22, 2002, observers in Perryville could see the volcano and reported that the intracaldera cone "was covered with ash and there was darkened snow all around the cone". The newly installed seismic network recorded sustained seismic activity and AVO raised the level-of-concern color code from green to yellow.

Continuing expansion. In 1996 AVO monitored four volcanoes with short-period seismometers. That number has grown to 24 volcanoes monitored with ground-based geophysical instruments and approximately 100 volcanoes in Alaska and Russia monitored by systematic satellite observations. In 2003, AVO installed new seismic networks on Gareloi and Tanaga volcanoes west of Adak. Data from these networks are radioed in real-time to Adak and then forwarded to AVO offices in Fairbanks and Anchorage for analysis. At the same time the networks were being installed AVO geologists conducted field studies to define the eruptive history of each volcano and thus determine expected future eruptive potential. Equipment and base mapping materials will be purchased in 2004 for use in 2005 when seismic networks will be installed at Little Sitkin and Cerberus volcanoes. Geologic mapping of those volcanoes will begin at the same time along with any follow-up studies or network maintenance needed at Gareloi and Tanaga.

Continued improvement in geophysical monitoring technology provides a much richer data stream. In the past AVO has relied on networks of about one-half dozen short-period seismometers clustered around potentially hazardous volcanoes. Several instruments are needed near each volcano to accurately record and locate the very small earthquakes associated with volcanic eruptions. In 2002 AVO deployed its first "superstations" to augment the short-period network. These stations have broadband seismometers and continuous telemetered GPS instruments in addition to the traditional short-period instruments. The broadband instruments provide a much more complete signal, particularly of the low-frequency "gurgling" associated with volcanic fluids. The GPS instruments will allow AVO to precisely track the swelling of volcanoes that accompanies the rise of magma. Networks of these instruments provide information on the size, shape, and location of the magma body. These stations require more power than traditional ones, and also require digital, rather than analog, telemetry. AVO is on the leading edge in developing remotely powered digital broadband and GPS stations.

Satellites extend AVO's capabilities to all Alaska volcanoes as well as the particularly active volcanoes of Kamchatka in the Russian far east, and those in the northern Kurile Islands. These remote, unmonitored, or poorly monitored volcanoes also pose a very real hazard to aviation in American-controlled airspace. Today AVO automatically processes hundreds of detailed subsections of satellite data and scans those data twice daily for thermal anomalies that indicate volcanic unrest, and may precede eruptions by weeks or months. Some eruptions, such as the 1997 eruption of the unmonitored volcano Okmok, were first detected using satellite data. Satellites are also used to track volcanic plumes as they drift downwind. In the spring of 2001, AVO monitored several large eruptions from unmonitored Cleveland Volcano, 150 miles west of Unalaska/Dutch Harbor. The satellite data stream has been augmented by the launch of the MODIS instrument and the installation of a receiving station at the UAF Geophysical Institute. MODIS is a high spatial resolution multispectral satellite.

Volcano hazards reports and geologic maps provide the "patient history" to complement "vital signs" collected by geophysical networks. These reports and maps document the past history of each volcano, which helps AVO staff anticipate the course and nature of future eruptions. Hazards reports also identify local infrastructure that may be at risk. DGGS plays important roles in field geology, sample analysis, and GIS work. We are presently on the teams working on multi-year projects at Veniaminof and Okmok volcanoes. DGGS has published the both Makushin and Shishaldin Volcano hazard reports, and will publish the Okmok report in 2004. Six geologic maps are in preparation (Spurr, Shishaldin, Veniaminof, Okmok, Tanaga, and Gareloi).

DGGS plays a vital role in AVO. DGGS is the smallest partner in AVO, contributing less than 10 percent of the personnel. More than 95 percent of DGGS's participation in AVO is funded by two cooperative agreements with the USGS, only one of which has dates that coincide with the state fiscal year. These cooperative agreements describe DGGS's tasks within AVO. Summaries and FY04 progress are below:

Helicopter logistics. DGGS manages helicopter procurement for all major AVO projects. In FY04 the helicopter expenses, including ship-based helicopter work in the western Aleutians, amounted to more than $700.0. Having all the helicopters contracted by a single agency results in significant budgetary and logistic efficiencies. As part of managing the helicopter budget DGGS also coordinates all AVO field project schedules so that the appropriate helicopters are available throughout the field season to meet the needs of each particular field party.

Geologic and Volcanic Hazards studies at Veniaminof, Okmok, Tanaga, and Gareloi volcanoes. DGGS provides field mapping, GIS, and geochemical sampling support to interagency teams working on Veniaminof, Okmok, Tanaga, and Gareloi volcanoes. At Okmok we have the lead in mapping the geology of the caldera walls and the precaldera shield. At Veniaminof we map as well as provide central management and oversight of samples and the evolving geochemical database. In FY04, DGGS continues to provide the primary GIS support and sample database administration for Okmok, Veniaminof, Tanaga, Gareloi, and Black Peak volcanoes, as well as continue our field mapping efforts at Okmok and Veniaminof volcanoes.

AVO World Wide Web site. DGGS was the original creator of the AVO Web site several years ago, and continues to be the site manager. DGGS has the primary responsibility for producing and maintaining the site (http://www.avo.alaska.edu), including all the HTML coding and graphics manipulation and most of the design. The site is in its fourth version, and is a heavily used site for information on active volcanoes in Alaska. We also maintain a library of PDF files to facilitate distribution of richly formatted AVO print publications and distribute hundreds of hazards reports on individual volcanoes digitally. DGGS also oversees the AVO internal Web site that displays complex near-real-time seismological and satellite data over the Web for project participants, making distributed monitoring possible, instead of monitoring only from within the lab. With an additional full-time geologist/database developer on staff in FY04, work has begun toward greatly increasing the content of the site. A full-time analyst/ programmer will also be on staff to help with the database-to-web interface, and to improve the graphic presentation and functionality of the web site.

Geologic Database of Information on Alaska Volcanoes (GeoDIVA). AVO/DGGS staff has primary oversight of database design, population, and distribution of the geologic information in GeoDIVA. The mission of GeoDIVA is to maintain complete, flexible, timely, and accurate geologic and geographic information on Pleistocene and younger Alaska volcanoes for scientific investigation, crisis response, and public information in a dynamic, digital format. This information system will be the most comprehensive, accurate, and up-to-date source of information on Alaska volcanoes. As information is collected and integrated into the database, it will become available on both the internal and public AVO websites, as well as in a series of publications on CD. The eruption history portion of the database is expected to be completed by December 31, 2004.

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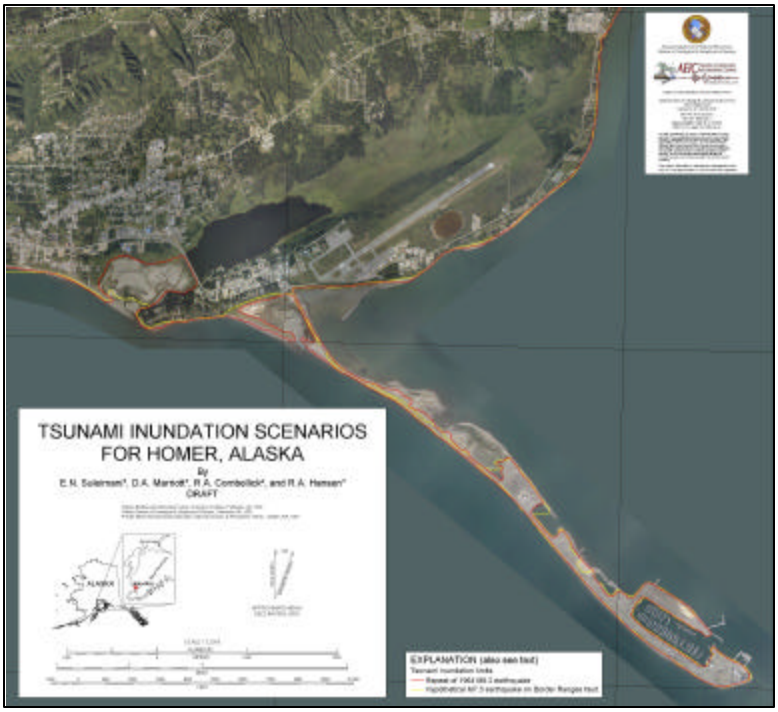
TSUNAMI INUNDATION MAPPING

With funding from Congress, the National Oceanic & Atmospheric Administration (NOAA) and Federal Emergency Management Agency (FEMA) initiated the National Tsunami Hazard Mitigation Program in 1997 to assist Pacific states in reducing losses and casualties from tsunamis. The program includes funding for five states (Alaska, Hawaii, Washington, Oregon, and California) to address four primary issues of concern: (1) quickly confirm potentially destructive tsunamis and reduce false alarms, (2) address local tsunami mitigation and the needs of coastal residents, (3) improve coordination and exchange of information to better utilize existing resources, and (4) sustain support at state and local level for long-term tsunami hazard mitigation.

As part of this program, DGGS is participating in a cooperative project with the Alaska Division of Emergency Services (ADES) and the University of Alaska Geophysical Institute (UAGI) to prepare tsunami-inundation maps of selected coastal communities. Kodiak was the first community selected for this project. During FY02, we completed and published maps of the Kodiak area to show estimated extent of inundation from tsunamis generated by seven hypothetical distant and nearby earthquakes. As a result of a meeting of local, state, and federal representatives in 1999, nine additional communities were selected and prioritized for future inundation mapping based on population, tsunami exposure, community interest, and data availability. Homer and Seldovia are the next communities for which we are currently preparing inundation maps based on two earthquake scenarios (see figure below). Maps and a report for Homer and Seldovia will be completed in FY2004. We have begun data compilation and inundation-modeling work for the next community, Seward, for which maps will be completed in FY2005.

In this program, we are developing inundation maps using complex numerical modeling of tsunami waves as they move across the ocean and interact with the seafloor and shoreline configuration in shallower nearshore water. UAGI is conducting the wave modeling using facilities at the Arctic Region Supercomputing Center. DGGS imports the results of this modeling to a Geographic Information System (GIS) database for use in depicting projected inundation limits on suitable base maps. DGGS, UAGI, and ADES meet with community leaders to communicate progress and results of the project, discuss format of resulting maps, and obtain community input regarding past tsunami effects and extent. DGGS publishes the final maps along with explanatory text, which are available in both hardcopy and digital formats. DGGS also makes the GIS files of inundation-limit lines available to the local communities for use in preparing their own tsunami-evacuation maps.



Draft tsunami-inundation map for Homer, Alaska. Red line: Estimated inundation limit for a repeat of the 1964 magnitude 9.2 earthquake. Yellow line: Estimated inundation limit for a hypothetical magnitude 7.5 earthquake on the Border Ranges fault.

During preparation of the Kodiak maps, comparison of the modeled 1964 inundation with the observed wave run-up in 1964 showed that the model produced comparable inundation. The maps also show that the modeled 1964 inundation nearly everywhere exceeds the inundation from all other credible source earthquakes. We have presented results of this project at international tsunami symposia in Istanbul, Turkey, and Seattle, Washington in 2001, at the Tsunami Society symposium in Honolulu, Hawaii, in 2002, and at the American Geophysical Union meeting in December 2003. This project was the subject of articles in *Geotimes* and *TsuInfo Alert Newsletter in 2002*.

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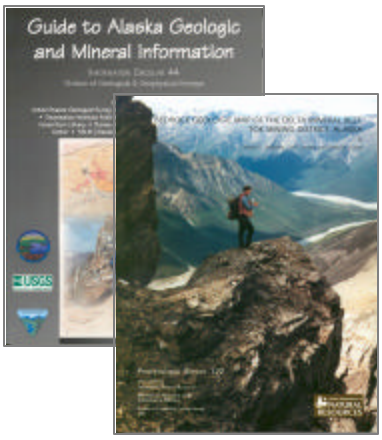
PUBLICATIONS PROJECT

The Publications Team is responsible for publishing and distributing the geologic data collected by staff in the Minerals, Energy, and Engineering Geology sections of DGGS. Team members are involved in many of the division's publication and outreach activities. Some of the functions they perform are:

- Staff DGGS's information counter to provide information concerning Alaska's geology.
- Manage sales of DGGS geologic reports, maps and data.
- Prepare displays and represent DGGS by providing staff for the DGGS booth at geologic conferences.
- Produce an annual report for the legislature and public, required by statute and written by the geologic staff, summarizing DGGS activities and communicating plans for its future projects.
- Publish newsletters each year that communicate DGGS progress and advertise the latest publications.
- Design, produce, and distribute an annual DGGS calendar.
- Perform design, layout, editing, and final production of technical and educational geologic maps and reports in both printed and digital formats.
- Review metadata for each project.
- Manage the DGGS library so that reports are available and locatable.
- Maintain a collection of reports of the U.S. Geological Survey, U.S. Bureau of Mines, and the U.S. Bureau of Land Management.
- Participate in school outreach activities such as helping prepare classroom presentations, judging science fair entries, or helping teachers with earth science units.



The publications produced by this group record and preserve geologic data such as: Definitive statistics for Alaska's mineral industry; detailed (1:63,360-scale) bedrock, surficial, and engineering geology for specific areas in the state; sources of Alaska's geologic information; annual information about DGGS's programs and accomplishments; geophysical data for areas with promising mineralization; and educational brochures and pamphlets explaining Alaska's geology or natural-science features. Some of the most recent DGGS publications include *Short Notes on Alaska Geology 2003*; *Alaska's Mineral Industry 2002*; and the *Bedrock geologic map of the Delta mineral Belt, Tok mining district, Alaska*. Publications are available on paper (printed on demand and sold for the cost of printing) and as PDF documents and scanned compressed maps on the World Wide Web (no charge).

FY 2004 plans include increasing the availability of digital datasets from which GIS maps are produced, so that customers can manipulate data in any way they choose, and publishing documents in digital format first, then using the digital publication to produce a paper copy when necessary. The availability of data encourages exploration of Alaska's natural resources and increases the dollars invested in Alaska's economy.

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GEOLOGIC EDUCATION AND OUTREACH

Education is a key component of facilitating economic growth and development of our geologic resources. It is important, and necessary, to involve our communities in the processes of resource development and hazards mitigation, and this begins with educating our fellow Alaskans about their local geology. DGGS staff participate in public outreach in a variety of ways: hosting educational workshops, giving presentations at geologic conventions, judging at local science fairs, assisting teachers with earth science curriculum, and speaking to students and community members about their local geology.

The DGGS Information Desk provides geologic information to the public on a wide range of topics including permafrost, mineral and energy resources, prospecting, and earthquakes. We also assist customers in understanding geological and geophysical maps and data. This function offers an important role as the point of contact for many people interested in Alaska geology.

The magnitude 7.9 earthquake on November 3, 2002, prompted Alaskans from around the state to contact DGGS for information about the Denali fault and other earthquake hazards in Alaska and about earthquake safety. After conducting an in-depth study of the earthquake in collaboration with the U.S. Geological Survey, a DGGS geologist conducted meetings to speak with community members in several communities close to the fault about the effects of the earthquake.

The Denali fault earthquake was of particular interest to younger age groups as well. Division staff organized a field trip for students from University Park Elementary in May 2003, after being contacted by teachers from this school. The students learned about rocks and minerals, geologic maps, and earthquakes.

A DGGS staff member worked with staff from Fort Knox to host a geologic station at BLM's Outdoor Days program in May 2003. This program educates local sixth-grade students about a variety of natural science topics. DGGS's station focused on mineral development and geologic mapping.

Workshops were also conducted for students from Minto and Nenana. Students from Minto were working on a mapping project through the Cultural Heritage and Education Institute (CHEI). Our workshop provided them the skills for utilizing topographic maps and satellite images as well as GPS for their project. Nenana students working on "Project Jukebox," a program through the University of Alaska, participated in a DGGS workshop on using GPS. The skills they gained allowed them to continue their work on mapping the historic Wood River Trail.

Community development is another important aspect of outreach and education. In association with an ongoing project to identify potential placer resources in the Council mining district, a DGGS geologist conducted educational workshops for communities on the Seward Peninsula. The objective of these workshops is to help local residents interpret and apply geologic and GIS products to their surrounding area.

Understanding our natural resources and their uses is key to diversifying Alaska's economic development. Educating Alaska's communities about our geological resources and natural hazards leads to continuing interest and facilitates growth through the utilization of our natural resources.

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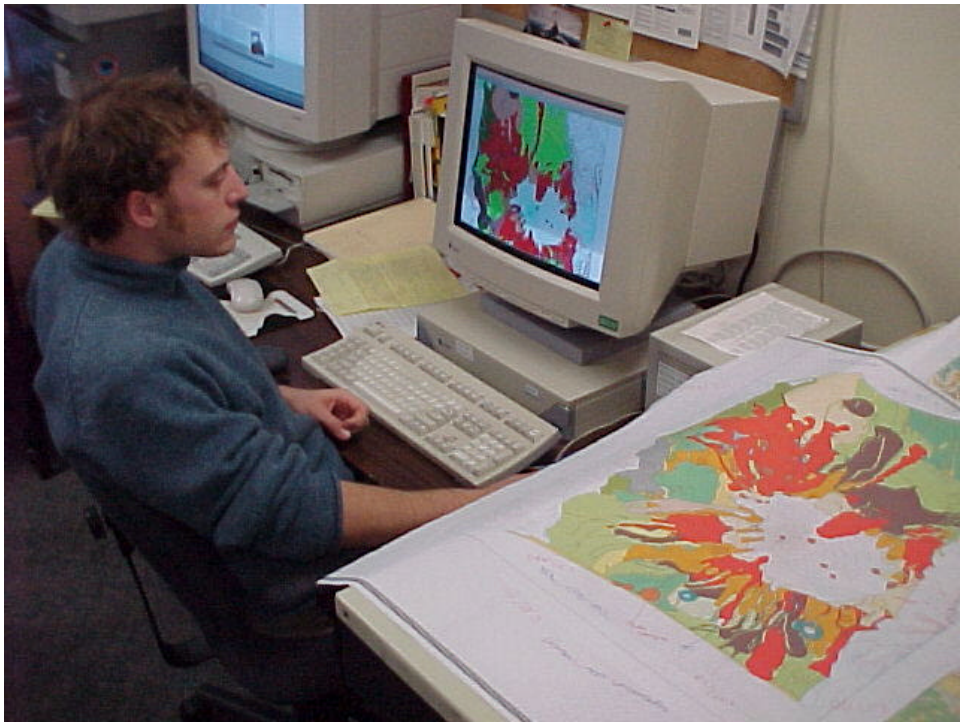
GIS–IT INFRASTRUCTURE PROJECT

The main focus of the Geographic Information Systems–Information Technology (GIS–IT) team is to provide primary computer and GIS service and support to DGGS staff and to streamline information delivery to the public. The team is made up of a Microcomputer/Network Specialist, a half-time Microcomputer/Network Technician, and a Cartographer.

DGGS IT staff identify projects that will provide improved computer services to our users. IT service initiatives completed this year included an upgrade of the Solaris operating environment to Solaris 9, installation of a DHCP server, and an upgrade of the SAMBA server, as well as configuration of a Gigabit LAN that is connected via Cisco Catalyst switches. In addition to IT service initiatives, over the last year DGGS IT staff were able to assist with several other DGGS projects. Most notably, we participated in the DGGS Database Project by installing and maintaining hardware and software for the Oracle server.

GIS users in the Division have benefited from the maintenance, upgrade, and support for ArcInfo licenses. The desktop GIS, Arc 8.1.2, implemented a year ago, has required new approaches to GIS that depart from our long-term Unix/ArcInfo background. To assist with GIS project work, the GIS staff have maintained plotters and digitizers and have participated in and completed maps for publications.

While providing DGGS staff with computers, network, and GIS, support is the primary function of the GIS–IT infrastructure project. Each year we embark on new projects, either to provide custom support or to improve the stability or efficiency of the support services we provide DGGS. Projects for FY2004 include upgrades to the current Web server and offering public access via the Internet to our geological database.



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U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER AND BULLETIN SCANNING AND DOCUMENT CONVERSION PROJECT

Over the last century the United States Geological Survey (USGS) has published a wealth of geologic research and information about the geology, natural resources, and geologic hazards of Alaska. Due to Alaska's difficult terrain and logistical challenges, legacy reports published by the USGS for many of the remote areas in Alaska remain the primary sources of geologic information. The maps, reports, and informational publications produced by the USGS in Alaska are widely utilized by oil companies, mining companies, resource-based companies, consultants, universities, schools, government agencies, scientists, and private individuals. With the exception of maps and reports published in the past few years, all of the USGS Alaska publications have existed solely on paper. The vast majority of these documents are rare and out of print. Convenient access to complete collections of Alaska USGS reports is effectively restricted to patrons of the Alaska Division of Geological & Geophysical Surveys (DGGS) library and research libraries in Fairbanks, Anchorage, and Juneau.

DGGS owns an extensive collection of Alaska-related USGS Bulletins and Professional Papers. The collection includes about 1,000 text reports, consisting of approximately 55,000 pages of text, photographs, data tables, and small (page-sized or up to 11 x 17 inch) illustrations. Various documents in the collection also include "oversize" (larger than 11 x 17 inch) illustrations (about 1,300 sheets). Funded by a grant from the USGS under the Minerals Data and Information Rescue in Alaska (MDIRA) Program, DGGS has undertaken the task of completing and cataloging this collection and converting the documents to digital files that will be archived (in TIF format) and made available for downloading via the DGGS Web site.

As with DGGS's previous document scanning and file conversion project for DGGS publications, the standard sized pages will be formatted as text-recognized Adobe Acrobat Portable Document Format (PDF) files and the "oversize" pages will be formatted as MrSID (Multiresolution Seamless Image Database by Lizardtech) files. DGGS has found that these formats offer an excellent compromise between image resolution and file size. Both formats can be read from almost all computer platforms using free viewer software distributed by http://www.adobe.com/ and http://www.lizardtech.com, respectively. The USGS Bulletin and Professional Paper collection will be searchable through DGGS's existing Web page infrastructure, which includes user-defined keyword, quadrangle, and publication series search options. Copies of resultant digital files will be submitted to the USGS and archived by DGGS to further protect and preserve the data contained within them.

As of December 2003, the document scanning, the standard page-size PFD file conversion, and the cataloging tasks required by this project are 90 percent complete. Over the next year DGGS will finish document scanning and file conversion, and integrate the document citation information into DGGS's Web page infrastructure. Preliminary PDF files of most documents in the collection are currently available upon request.

For the future, DGGS has proposed and received tentative approval for a similar project that would include Alaska-related USGS Open-File Reports, Miscellaneous Field Studies, Geologic Quadrangle Maps, Miscellaneous Investigations/ Geologic Investigations, Mineral Investigations Resources Maps, and various other short series USGS publications. We are also investigating options for further enhancing users' ability to query these files and retrieve multiple documents from the Web site. Completion of the USGS Bulletin and Professional Paper scanning project will almost double the number of investigative documents in DGGS's "virtual library," making it a truly powerful tool for distributing information about Alaska's geologic resources.

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DIGITAL GEOLOGIC DATABASE PROJECT

In October 2000, the Division of Geological & Geophysical Surveys (DGGS) began creating a geologic database system that will provide consistent data and information input, organization, and storage architecture. The database system will also provide data identification and retrieval functions that will guide and encourage users to access appropriate data on-line. This project is part of the Federally funded Minerals Data and Information at Risk in Alaska (MDIRA) program.

Digital Geologic Database Project has three primary objectives The first is to establish a spatially referenced geologic database system in a centralized data and information architecture with networked data access for new DGGS geologic data. The second objective is to create a functional on-line system that allows the public to find and identify the type and geographic locations of geologic data available from DGGS and then view or download the selected data. The third objective is to cooperatively integrate DGGS minerals-related data with data from other agencies through a MDIRA Web page <http://akgeology.info>.

During the first 3 years, the project work group identified geologic data for inclusion in the database, created a secure and stable database structure, moved publications index information into the database, and is now serving that information to the public through the DGGS Web site <http://www.dggs.dnr.state.ak.us> and through the MDIRA Geologic Map Search Engine <http://maps.akgeology.info/>. The project group also implemented a method to make DGGS spatial data indexes (metadata) available to the Alaska State Geospatial Data Clearinghouse (ASGDC) <http://www.asgdc.state.ak.us/>. The next additions to the database will be DGGS Geographic Information System (GIS) index information and geochemical data.

A spatially referenced geologic database includes location and geometry of spatially referenced information. Examples of spatially referenced information in the DGGS database include geologic sample locations, fault surface traces, areas covered by geologic maps, or surface exposures of geologic formations. All of the information in a spatially referenced database can be used in spatial analysis; for instance, a miner can find all geologic maps in the area of a gold prospect. Geologic data to be contained in the DGGS database include bibliographic information, geologic map features, field observations, sample descriptions and analyses, minerals resource data, and information for evaluating geologic hazards. Spatially referencing descriptive and analytical information in a relational database structure will allow members of the community to search more effectively for geologic information specific to their needs.

The database system infrastructure consists of a data server, relational database management software, and utilities to interface with the DGGS Local Area Network (LAN) and Geographic Information System (GIS). The database is available to DGGS staff through the DGGS LAN using GIS software, database client software, and Web-based forms. The public will be able to access the information through the DGGS Web site via listings of publications and their associated data as well as through live search engines allowing selection of customized data independent of individual project areas or publication. Minerals-related data will be also accessible through the MDIRA interagency data portal, which is concurrently under development by DNR. Ongoing development of data input forms, Web-based query forms, and Web data viewing templates will provide staff and public additional improved access to DGGS data.

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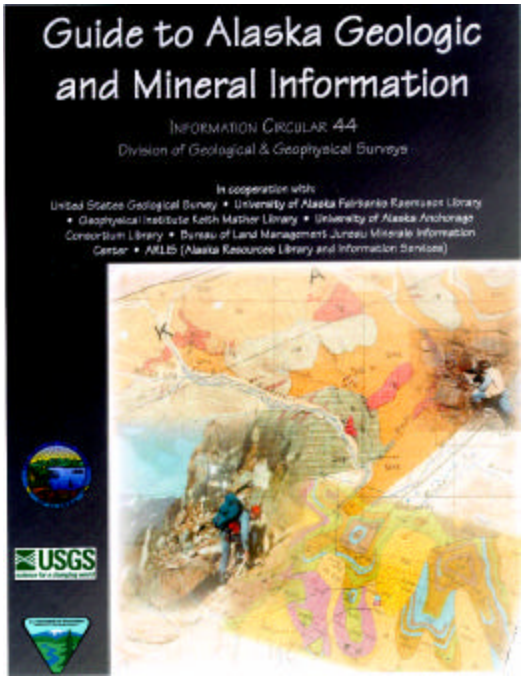
GUIDE TO ALASKA GEOLOGIC AND MINERALS INFORMATION

The Division of Geological and Geophysical Surveys (DGGS) currently is updating the popular *Guide to Alaska Geologic and Mineral Information*, which was first published in 1998 as Information Circular (IC) 44. Like the original document, the updated publication will be available as a full-color, professionally printed volume of approximately 85 pages, and in two Web-based versions—an HTML-based Web site and a downloadable PDF file. The printed version will be available free of charge to the public, and reference copies will be available at libraries, information centers, and selected government agencies in Alaska. Publication is expected to be completed in March 2004.

The Guide identifies informational resources for topics that range from geology and mineral occurrences, to non-technical or ancillary issues such as permitting and land ownership and use. Although targeted to the mining and mineral exploration community, many resources identified in the Guide are relevant to the oil and gas and coal exploration industries, to the general geologic community, and to organizations and agencies that gather, disseminate, or utilize information about mining and geology in Alaska.



Resources in the Guide include those organizations that create and publish geologic and mineral industry information in Alaska; organizations that hold, distribute, or lend information such as libraries, agencies, and archives; Web-based and other digital sources of data; and sources of specific information about a wide variety of technical and regulatory/permitting issues that affect mineral exploration in Alaska.

The information in the Guide has been updated extensively to reflect, for example, changes in agency roles, changes in physical and electronic addresses, many new and expanded sources of digital maps and data, and the addition of online databases of land status and land-use records. The layout of the document and the Web site were changed very little, and consequently the new version of the Guide will be familiar to previous users.

Librarians from the eight major research collections in Alaska were the principal sources of information for the Guide. These include: Alaska Resource Library and Information Service (ARLIS, Cathy Vitale), UAA Consortium Library, USGS Technical Data Unit (Jill Schneider), UAF Rasmuson Library (John Kawula), Geophysical Institute Library (Julia Triplehorn), the Alaska State Library (Kay Shelton), DGGS (Dawn Roberts), and Bureau of Land Management Juneau Mineral Information Center (Jane Albrecht). A contract editor, Ellen Daley, Ph.D., is compiling and editing the Guide, and has been working with the librarians' group and DGGS Geologic Communications personnel to finalize the document.

This publication is a small part of the Minerals Data and Information Rescue in Alaska (MDIRA) program, which is a cooperative effort of DGGS, the U.S. Geological Survey (USGS), Bureau of Land Management (BLM), and major research libraries in Alaska. The goal of this program is to improve the quality and accessibility of mineral information in Alaska. Such information is seen as critical in making informed decisions about mineral development, land use, and future legislation related to minerals in Alaska.

Contact Gail Davidson, Chief, Geologic Communications, 907-451-5006, gail@dnr.state.ak.us

DGGS WEB PAGE

http://www.dggs.dnr.state.ak.us

During FY03, the DGGS Web site experienced a 28 percent increase in visits over FY02, for a total of 41,935 hits. This increase was in large part a result of the Denali Fault Earthquake in November 2002, which drew a large number of visitors to the site. The Generalized Geologic Map of Alaska continued to be popular, as did the extensive series of scanned DGGS publications and maps.

In order of popularity, the files downloaded most in FY03 were RI 2002-1, *Tsunami Hazard Maps of the Kodiak Area, Alaska*; the page-sized *Generalized Geologic Map of Alaska*; LR 2, *Analysis of Copper, Lead, and Zinc by Atomic Absorption Spectrophotometry*; and MP 01, *The Great Alaska Earthquake, March 27, 1964*.

DGGS is presently scanning U.S. Geological Survey Bulletins and Professional Papers on Alaska geology to make them available on the DGGS Web site. Also in the works is a system for presenting scanned DGGS publications from the developing Division-wide database as they are published, which will keep the formerly static publications pages up to date. Other information from the database will be available on the Web site as applications are developed.

Contact Gail Davidson, Chief, Geologic Communications, 907-451-5006, gail@dnr.state.ak.us

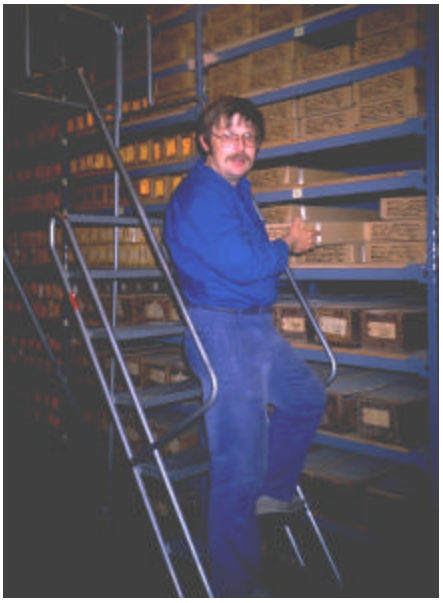
GEOLOGIC MATERIALS CENTER

The Alaska Geologic Materials Center (GMC) in Eagle River holds nonproprietary rock core and cuttings that represent nearly 12 million feet of exploration and production drilling that were derived from Federal, State, and private lands of Alaska, including the Alaska outer continental shelf. This collection includes rock materials from over 1,300 oil and gas exploratory or production wells, rock core from over 1,000 exploratory hard-rock mineral holes, and surface samples. The collection also includes extensive geochemical data, petrographic thin sections, and paleontological glass slides derived from this rock. Additionally, there are 206,650 feet of diamond-drilled hard rock mineral core stored at the GMC.

The GMC is operated by the Alaska Department of Natural Resources, Division of Geological & Geophysical Surveys. The GMC cooperating government agencies are the U.S. Bureau of Land Management, U.S. Geological Survey, U.S. Minerals Management Service, and Alaska Oil and Gas Conservation Commission. The basic concept of the GMC is to be an archive facility for all worthwhile rock samples collected in the state of Alaska and on the Alaska outer continental shelf. The chief user of the GMC is oil and gas industry, although use by the minerals industry, government, and academic institutions is increasing.

As of mid January, the GMC has had 205 visitations and 1,289 contacts during FY04. It has also received 424 processed oil/gas petrographic–microfossil–geochemical glass slides and 2 technical data reports. There were a total of 439 visitations and 2,492 contacts to/with the facility for FY03, and similar numbers are expected for FY04.

For FY04, the GMC has successfully received, stored, and is in the process of inventorying seven 40-foot trailer loads of rock samples: representing collections from BP Exploration (Alaska) Badami oil field and part of their exploratory well-sample collection for the rest of arctic Alaska, the Union Oil Co. of California Amoco oil/gas well-sample collection for Cook Inlet (Middle Ground Shoal and Granite Point fields), the CIRI hard-rock mineral core and oil/gas well-sample collections, the Canalaska Resources hard-rock mineral core collection of Valdez Creek, the Kennecott hard-rock mineral core Napoleon prospect collection from Chicken, part of the DGGS surface-rock collection, and the "released" Alaska Oil and Gas Conservation Commission well samples. In total, samples for more than 174 oil/gas wells and more than 19 hard-rock mineral holes were received/donated. The GMC has also received as donations an additional five metal CONNEX containers of 40-foot length (four from BP Exploration [Alaska] Inc. and one from the University of Alaska Anchorage [ARLIS]) that are entirely shelved. The GMC now has a total of 52 shelved CONNEX containers with 8 still empty of any samples. No additional large donations are expected for the rest of FY04.



Contact: John Reeder, Geologic Materials Center, 907-696-0079, john_reeder@dnr.state.ak.us

PUBLICATIONS RELEASED IN FY03 AND TO DATE IN FY04

GEOPHYSICAL MAPS & REPORTS

GPR 2003_5. Plot files of the airborne geophysical survey data of the southern Delta River area, east-central Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2003, **1 CD-ROM**. Contains the 19 maps listed below as GPR2003_5_xy in both HPGL/2 format and postscript printer format. The **HPGL2 plot files** (prn printer file format) were made with an HP Designjet 2500 HPGL/2 printer driver v4.61 and **must be plotted on an HP Designjet 2500.** The **postscript plot files** (ps printer file format) were made with an Hewlett Packard Designjet 2500 Postscript 3 printer driver v5.0 and **should plot on all Hewlett Packard plotters that can interpret postscript 3 files.** $10.

GPR 2003_5_1a. Total magnetic field of the southern Delta River area, east-central Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2003, 2 sheets, **scale 1:63,360. Topography included. Full-color plot** from electronic file, 600 dpi. $26.

GPR 2003_5_1b. Total magnetic field of the southern Delta River area, east-central Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2003, 2 sheets, **scale 1:63,360. Magnetic contours and section lines included. Full-color plot** from electronic file, 600 dpi. $26.

GPR 2003_5_1c. Color shadow magnetic map of the southern Delta River area, east-central Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2003, 2 sheets, **scale 1:63,360. Full-color plot** from electronic file, 600 dpi. $26.

GPR 2003_5_1d. Total magnetic field and electromagnetic anomalies of the southern Delta River area, east-central Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2003, 2 sheets**, scale 1:63,360. Magnetic contours, simplified electromagnetic anomalies, and section lines included**. **Black and white plot** from electronic file, 600 dpi. $8.

GPR 2003_5_2a. Total magnetic field and detailed electromagnetic anomalies of the southern Delta River area, east-central Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2003, 1 sheet, **scale 1:31,680 (parts of Mt. Hayes A-5, A-6, B-5, and B-6 quadrangles). Magnetic contours, detailed electromagnetic anomalies, and topography included**. **Black and white plot** from electronic file, 600 dpi. $3.

GPR 2003_5_2b. Total magnetic field and detailed electromagnetic anomalies of the southern Delta River area, east-central Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2003, 1 sheet, **scale 1:31,680** (**parts of Mt. Hayes A-4, A-5, B-4, and B-5 quadrangles**). **Magnetic contours, detailed electromagnetic anomalies, and topography included. Black and white plot** from electronic file, 600 dpi. $3.

GPR 2003_5_2c. Total magnetic field and detailed electromagnetic anomalies of the southern Delta River area, east-central Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2003, 1 sheet, **scale 1:31,680** (**parts of Mt. Hayes A-3, A-4, B-3, and B-4 quadrangles**). **Magnetic contours, detailed electromagnetic anomalies, and topography included. Black and white plot** from electronic file, 600 dpi. $5.

GPR 2003_5_2d. Total magnetic field and detailed electromagnetic anomalies of the southern Delta River area, east-central Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2003, 1 sheet, **scale 1:31,680** (**parts of Mt. Hayes A-5 Quadrangle**). **Magnetic contours, detailed electromagnetic anomalies, and topography included. Black and white plot** from electronic file, 600 dpi. $3.

GPR 2003_5_2e. Total magnetic field and detailed electromagnetic anomalies of the southern Delta River area, east-central Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Manage-

ment Corp., 2003, 1 sheet, **scale 1:31,680 (parts of Mt. Hayes A-4 and A-5 quadrangles). Magnetic contours, detailed electromagnetic anomalies, and topography included. Black and white plot** from electronic file, 600 dpi. $3.

GPR 2003_5_2f. Total magnetic field and detailed electromagnetic anomalies of the southern Delta River area, east-central Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2003, 1 sheet, **scale 1:31,680 (parts of Mt. Hayes A-4 Quadrangle). Magnetic contours, detailed electromagnetic anomalies, and topography included. Black and white plot** from electronic file, 600 dpi. $3.

GPR 2003_5_2g. Total magnetic field and detailed electromagnetic anomalies of the southern Delta River area, east-central Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2003, 1 sheet, **scale 1:31,680 (parts of Mt. Hayes A-3 and A-4 quadrangles). Magnetic contours, detailed electromagnetic anomalies, and topography included. Black and white plot** from electronic file, 600 dpi. $3.

GPR 2003_5_3a. 7200 Hz coplanar resistivity of the southern Delta River area, east-central Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2003, 2 sheets, **scale 1:63,360. Topography included. Full-color plot** from electronic file, 600 dpi. $26.

GPR 2003_5_3b. 7200 Hz coplanar resistivity of the southern Delta River area, east-central Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2003, 2 sheets, **scale 1:63,360. Resistivity contours and section lines included. Full-color plot** from electronic file, 600 dpi. $26.

GPR 2003_5_3c. 7200 Hz coplanar resistivity of the southern Delta River area, east-central Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2003, 2 sheets, **scale 1:63,360. Resistivity contours and section lines included. Black and white plot** from electronic file, 600 dpi. $8.

GPR 2003_5_4a. 900 Hz coplanar resistivity of the southern Delta River area, east-central Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2003, 2 sheets, **scale 1:63,360. Topography included. Full-color plot** from electronic file, 600 dpi. $26.

GPR 2003_5_4b. 900 Hz coplanar resistivity of the southern Delta River area, east-central Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2003, 2 sheets, **scale 1:63,360. Resistivity contours and section lines included. Full-color plot** from electronic file, 600 dpi. $26.

GPR 2003_5_4c. 900 Hz coplanar resistivity of the southern Delta River area, east-central Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2003, 2 sheets, **scale 1:63,360. Resistivity contours and section lines included. Black and white plot** from electronic file, 600 dpi. $8.

GPR 2003_5_5a. Flight lines of the southern Delta River area, east-central Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2003, 2 sheets, scale 1:63,360. **Topography included. Black and white plot** from electronic file, 600 dpi. $8.

GPR2003_5_6a. Digital elevation model of the the southern Delta River area, east-central Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2003, 2 sheets, **scale 1:63,360. Elevation contours and section lines included.** Produced from survey altimetry. **Full-color plot** from electronic file, 600 dpi. $26.

GPR 2003_6. Line, grid, and vector data of airborne geophysical survey data for the southern Delta River area, east-central Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2003, **1 CD-ROM. Line data in ASCII format; gridded data in Geosoft format; vector files in Autocad 14 dxf files.** $20.

GPR 2003_7. Project report of the airborne geophysical survey of the southern Delta Rvier area, east-central Alaska, by Ruth Pritchard, Fugro Airborne Surveys, 2003, 252 p., 2 sheets, scale 1:63,360. $30.

GPR 2003_8. Portfolio of aeromagnetic and resistivity maps of the southern Delta River area, east-central Alaska, by L.E. Burns and K.H. Clautice, 2003, 15 p. **Includes color and shadow maps. Maps fit 8½" x 11" sheet.** $6.

GPR 2003_9. Plot files of the airborne geophysical survey data of the Sleetmute area, southwestern

Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2003, **1 CD-ROM**. Contains the **18 maps** listed below as GPR2003_9_xy in both HPGL/2 format and postscript printer format. The **HPGL2 plot files** (prn printer file format) were made with an HP Designjet 2500 HPGL/2 printer driver v4.61 and **must be plotted on an HP Designjet 2500.** The **postscript plot files** (ps printer file format) were made with an Hewlett Packard Designjet 2500 Postscript 3 printer driver v5.0 and **should plot on all Hewlett Packard plotters that can interpret postscript 3 files.** $10.

GPR 2003_9_1a. Total magnetic field of the Sleetmute area, southwestern Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2003, 2 sheets, **scale 1:63,360**. **Topography included. Full-color plot** from electronic file, 600 dpi. $26.

GPR 2003_9_1b. Total magnetic field of the Sleetmute area, southwestern Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2003, 2 sheets, **scale 1:63,360. Magnetic contours and section lines included. Full-color plot** from electronic file, 600 dpi. $26.

GPR 2003_9_1c. Color shadow magnetic map of the Sleetmute area, southwestern Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2003, 2 sheets, **scale 1:63,360. Full-color plot** from electronic file, 600 dpi. $26.

GPR 2003_9_1d. Total magnetic field and electromagnetic anomalies of the Sleetmute area, southwestern Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2003, 2 sheets, **scale 1:63,360. Magnetic contours, simplified electromagnetic anomalies, and section lines included. Black and white plot** from electronic file, 600 dpi. $8.

GPR 2003_9_2a. Total magnetic field and detailed electromagnetic anomalies of the Sleetmute area, southwestern Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2003, 1 sheet, **scale 1:31,680** (**part of Iditarod A-4 Quadrangle**). **Magnetic contours, detailed electromagnetic anomalies, and topography included. Black and white plot** from electronic file, 600 dpi. $4.

GPR 2003_9_2b. Total magnetic field and detailed electromagnetic anomalies of the Sleetmute area, southwestern Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2003, 1 sheet, **scale 1:31,680 (parts of Sleetmute D-5 and D-6 quadrangles)**. **Magnetic contours, detailed electromagnetic anomalies, and topography included. Black and white plot** from electronic file, 600 dpi. $4.

GPR 2003_9_2c. Total magnetic field and detailed electromagnetic anomalies of the Sleetmute area, southwestern Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2003, 1 sheet, **scale 1:31,680** (**parts of Sleetmute D-4 and D-5 quadrangles**). **Magnetic contours, detailed electromagnetic anomalies, and topography included. Black and white plot** from electronic file, 600 dpi. $4.

GPR 2003_9_2d. Total magnetic field and detailed electromagnetic anomalies of the Sleetmute area, southwestern Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2003, 1 sheet, **scale 1:31,680** (**parts of Sleetmute C-5, C-6, D-5 and D-6 quadrangles**). **Magnetic contours, detailed electromagnetic anomalies, and topography included. Black and white plot** from electronic file, 600 dpi. $4.

GPR 2003_9_2e. Total magnetic field and detailed electromagnetic anomalies of the Sleetmute area, southwestern Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2003, 1 sheet, **scale 1:31,680** (**parts of Sleetmute C-4, C-5, D-4 and D-5 quadrangles**). **Magnetic contours, detailed electromagnetic anomalies, and topography included. Black and white plot** from electronic file, 600 dpi. $4.

GPR 2003_9_2f. Total magnetic field and detailed electromagnetic anomalies of the Sleetmute area, southwestern Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2003, 1 sheet, **scale 1:31,680** (**parts of Sleetmute C-4 and C-5 quadrangles**). **Magnetic contours, detailed electromagnetic anomalies, and topography included. Black and white plot** from electronic file, 600 dpi. $4.

GPR 2003_9_3a. 7200 Hz coplanar resistivity of the Sleetmute area, southwestern Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro

Airborne Surveys, and Stevens Exploration Management Corp., 2003, 2 sheets, **scale 1:63,360. Topography included. Full-color plot** from electronic file, 600 dpi. $26.

GPR 2003_9_3b. 7200 Hz coplanar resistivity of the Sleetmute area, southwestern Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2003, 2 sheets, **scale 1:63,360. Resistivity contours and section lines included. Full-color plot** from electronic file, 600 dpi. $26.

GPR 2003_9_3c. 7200 Hz coplanar resistivity of the Sleetmute area, southwestern Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2003, 2 sheets, **scale 1:63,360. Resistivity contours and section lines included. Black and white plot** from electronic file, 600 dpi. $8.

GPR 2003_9_4a. 900 Hz coplanar resistivity of the Sleetmute area, southwestern Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2003, 2 sheets, **scale 1:63,360. Topography included. Full-color plot** from electronic file, 600 dpi. $26.

GPR 2003_9_4b. 900 Hz coplanar resistivity of the Sleetmute area, southwestern Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2003, 2 sheets, **scale 1:63,360. Resistivity contours and section lines included. Full-color plot** from electronic file, 600 dpi. $26.

GPR 2003_9_4c. 900 Hz coplanar resistivity of the Sleetmute area, southwestern Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2003, 2 sheets, **scale 1:63,360. Resistivity contours and section lines included. Black and white plot** from electronic file, 600 dpi. $8.

GPR 2003_9_5. Flight lines of the Sleetmute area, southwestern Alaska, by L.E. Burns, U.S. Bureau of Land Management, Fugro Airborne Surveys, and Stevens Exploration Management Corp., 2003, 2 sheets, **scale 1:63,360. Topography included. Black and white** plot from electronic file, 600 dpi. $8.

GPR 2003_10. Line, grid, and vector data of the airborne geophysical survey data of the Sleetmute area, southwestern Alaska, **1 CD-ROM set. Line data in ASCII format; gridded data in Geosoft and ER Mapper format; vector files in Autocad 13 dxf files.** $20.

GPR 2003_11. Project report of the airborne geophysical survey of the Sleetmute area, southwestern Alaska, by Ruth Pritchard, Fugro Airborne Surveys, 2003, 211, p., 2 sheets, scale 1:63,360. $30.

GPR 2003_12. Portfolio of aeromagnetic and resistivity maps of the Sleetmute area, southwestern Alaska, **Includes color and shadow maps. Maps fit 8½" x 11" sheet.** To be determined

INFORMATION CIRCULARS

IC 49. Alaska's mineral industry 2002: a summary, by D.J. Szumigala and R.C. Swainbank, 2003, 15 p. Free.

IC 50. Alaska's mineral industy 2003: a summary, by D.J. Szumigala and R.H. Harris, 2004, 12 p. Free.

MISCELLANEOUS PUBLICATIONS

MP 58. Survey of geology and geologic materials, and geologic hazards in proposed access corridors in the Chandalar Quadrangle, Alaska, by D.S.P. Stevens and R.L. Smith, 5 sheets, scale 1:250,000. $65.

MP 59. Survey of geology and geologic materials, and geologic hazards in proposed access corridors in the Chandler Lake Quadrangle, Alaska, by D.S.P. Stevens and R.L. Smith, 5 sheets, scale 1:250,000. $65.

MP 61. Survey of geology and geologic materials, and geologic hazards in proposed access corridors in the Chignik Point Quadrangle, Alaska, by R.D. Reger, K.M. Campbell, D.S.P. Stevens, and R.L. Smith, 5 sheets, scale 1:250,000. $65.

MP 66. Survey of geology and geologic materials, and geologic hazards in proposed access corridors in the Demarcation Point Quadrangle, Alaska, by D.S.P. Stevens and R.L. Smith, 5 sheets, scale 1:250,000. $65.

MP 67. Survey of geology and geologic materials, and geologic hazards in proposed access corridors in the Dillingham Quadrangle, Alaska, by R.D. Reger, D.S.P. Stevens, and R.L. Smith, 4 sheets, scale 1:250,000. $52.

MP 68. Survey of geology and geologic materials, and geologic hazards in proposed access corridors in the Eagle Quadrangle, Alaska, by R.D. Reger, D.S.P. Stevens, and R.L. Smith, 5 sheets, scale 1:250,000. $65.

MP 69. Survey of geology and geologic materials, and geologic hazards in proposed access corridors in the Fairbanks Quadrangle, Alaska, by R.D. Reger, D.S.P. Stevens, and R.L. Smith, 5 sheets, scale 1:250,000. $65.

MP 72. Survey of geology and geologic materials, and geologic hazards in proposed access corridors in the Healy Quadrangle, Alaska, by R.D. Reger, D.S.P. Stevens, and R.L. Smith, 5 sheets, scale 1:250,000. $65.

MP 73. Survey of geology and geologic materials, and geologic hazards in proposed access corridors in the Holy Cross Quadrangle, Alaska, by H.R. Livingston, G.R. Cruse, D.S.P. Stevens, and R.L. Smith, 5 sheets, scale 1:250,000. $65.

MP 75. Survey of geology and geologic materials, and geologic hazards in proposed access corridors in the Hughes Quadrangle, Alaska, by R.D. Reger, D.S.P. Stevens, and R.L. Smith, 5 sheets, scale 1:250,000. $65.

MP 76. Survey of geology and geologic materials, and geologic hazards in proposed access corridors in the Iditarod Quadrangle, Alaska, by R.D. Reger, G.R. Cruse, D.S.P. Stevens, and R.L. Smith 4 sheets, scale 1:250,000. $52

MP 80. Survey of geology and geologic materials, and geologic hazards in proposed access corridors in the Kantishna River Quadrangle, Alaska, by D.S.P. Stevens and R.L. Smith, 5 sheets, scale 1:250,000. $65.

MP 81. Survey of geology and geologic materials, and geologic hazards in proposed access corridors in the Karluk Quadrangle, Alaska, by D.S.P. Stevens and R.L. Smith, 5 sheets, scale 1:250,000. $65.

MP 82. Survey of geology and geologic materials, and geologic hazards in proposed access corridors in the Kateel River Quadrangle, Alaska, by R.D. Reger, G.R. Cruse, D.S.P. Stevens, and R.L. Smith, 5 sheets, scale 1:250,000. $65.

MP 86. Survey of geology and geologic materials, and geologic hazards in proposed access corridors in the Livengood Quadrangle, Alaska, by R.D. Reger, D.S.P. Stevens, and R.L. Smith, 5 sheets, scale 1:250,000. $65

MP 87. Survey of geology and geologic materials, and geologic hazards in proposed access corridors in the Lookout Ridge Quadrangle, Alaska, by D.S.P. Stevens and R.L. Smith, 5 sheets, scale 1:250,000. $65

MP 88. Survey of geology and geologic materials, and geologic hazards in proposed access corridors in the McGrath Quadrangle, Alaska, by R.D. Reger, D.S.P. Stevens, and R.L. Smith, 5 sheets, scale 1:250,000. $65.

MP 89. Survey of geology and geologic materials, and geologic hazards in proposed access corridors in the Meade River Quadrangle, Alaska, by R.D. Reger, D.S.P. Stevens, N.D. Bowman, K.M. Campbell, and R.L. Smith, 5 sheets, scale 1:250,000. $65.

MP 91. Survey of geology and geologic materials, and geologic hazards in proposed access corridors in the Melozitna Quadrangle, Alaska, by R.D. Reger, D.S.P. Stevens, and R.L. Smith, 5 sheets, scale 1:250,000. $65.

MP 94. Survey of geology and geologic materials, and geologic hazards in proposed access corridors in the Mount McKinley Quadrangle, Alaska, by R.D. Reger, D.S.P. Stevens, and R.L. Smith, 5 sheets, scale 1:250,000. $65.

MP 97. Survey of geology and geologic materials, and geologic hazards in proposed access corridors in the Noatak Quadrangle, Alaska, by D.S.P. Stevens, K.M. Campbell, and R.L. Smith, 4 sheets, scale 1:250,000. $52.

MP 127. Alaska coalbed and shallow gas resources, May 2001 Workshop Proceedings, edited by C.E. Barker. J.G. Clough, and T.A. Dallegge, 2003, 1 CD-ROM. $10.

MP 131. Bibliography of information on Alaska volcanoes, by C.E. Cameron, J.H. Triplehorn, and C.L. Robar, 2003, 1 CD-ROM. $10.

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