Alaska Division of Geological & Geophysical Surveys

Annual Report 2008

Northern Brooks Range Foothills

Alaska Highway Corridor

Cook Inlet

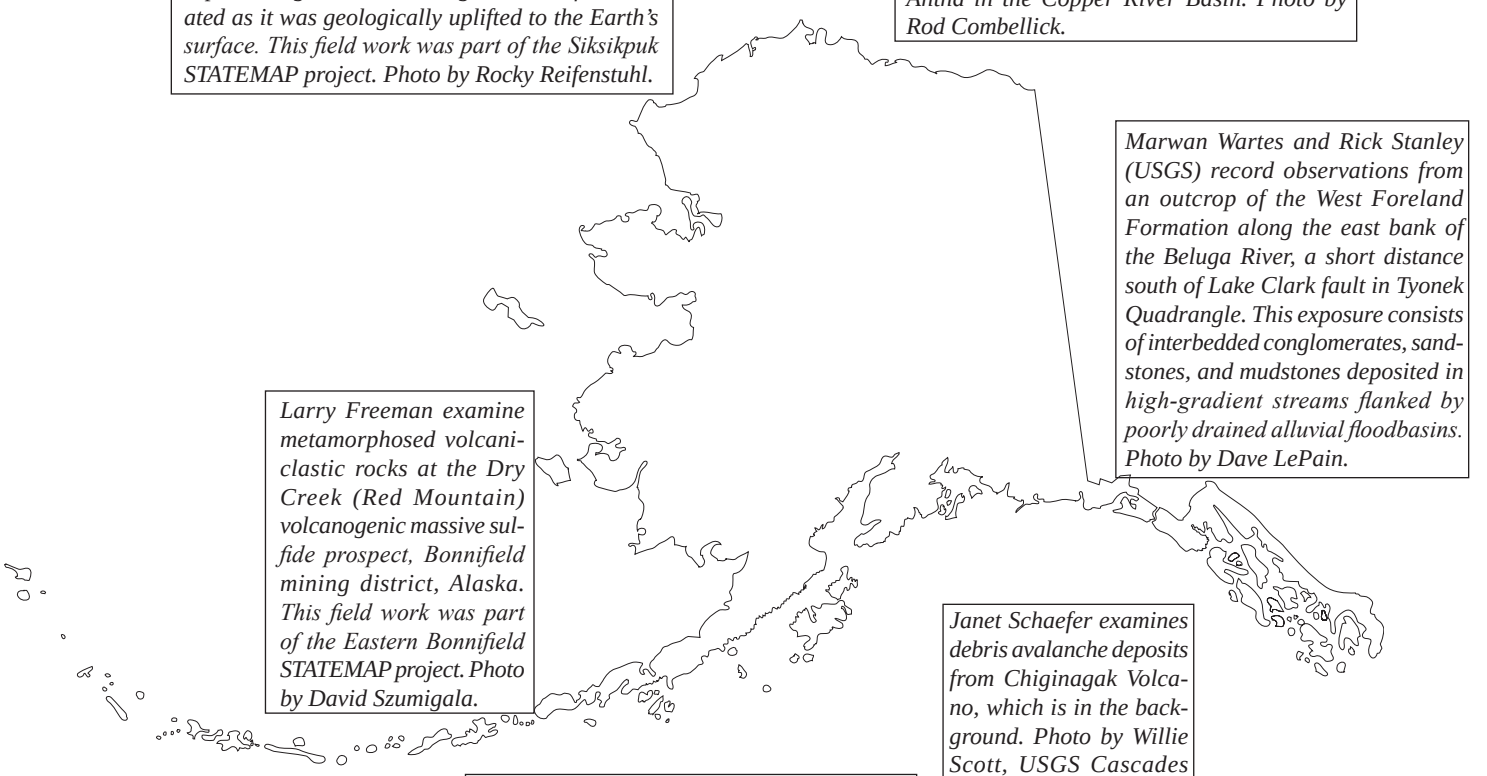
Central Alaska Range

Chiginagak Volcano

Bristol Bay—Alaska Peninsula

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

Alaska Division of Geological & Geophysical Surveys
Annual Report 2008



Trent Hubbard and Richard Reger examine glacial-outburst flood deposits in a gravel pit near Tok as part of the Alaska Highway Corridor Geologic Hazards & Resources Project. These sediments, which underlie much of the Tok area, were deposited when meltwaters breached a dam in the Mentasta Pass area during Donnelly glaciation of Wisconsin age, and surged down the Tok River into the upper Tanana River valley. Pebble and cobble lithologies indicate that the materials came, at least in part, from the area covered by glacial lake Ahtna in the Copper River Basin. Photo by Rod Combellick.

Bob Swenson (left) and Gil Mull on Autumn Creek, a tributary of the Siksikpuk River in the Brooks Range foothills, North Slope. Chaotic deposits of the Early Cretaceous Torok Formation contain inclusions of gilsonite. This black, solid, bitumen asphaltite, also known as uintahite, originated at depth as migrated oil that degraded and fractionated as it was geologically uplifted to the Earth's surface. This field work was part of the Siksikpuk STATEMAP project. Photo by Rocky Reifenstuhl.

Marwan Wartes and Rick Stanley (USGS) record observations from an outcrop of the West Foreland Formation along the east bank of the Beluga River, a short distance south of Lake Clark fault in Tyonek Quadrangle. This exposure consists of interbedded conglomerates, sandstones, and mudstones deposited in high-gradient streams flanked by poorly drained alluvial floodbasins. Photo by Dave LePain.

Larry Freeman examine metamorphosed volcaniclastic rocks at the Dry Creek (Red Mountain) volcanogenic massive sulfide prospect, Bonnifield mining district, Alaska. This field work was part of the Eastern Bonnifield STATEMAP project. Photo by David Szumigala.

Janet Schaefer examines debris avalanche deposits from Chiginagak Volcano, which is in the background. Photo by Willie Scott, USGS Cascades Volcano Observatory.

View northeast of Rocky Reifenstuhl standing on Miocene-age Bear Lake Formation, marine fossil-rich sandstone, 20 km east of Port Moller, Alaska Peninsula. In the background are tectonically deformed Pliocene-age, volcaniclastic-rich, Milky River Formation marine sediments, and the Milky River valley. Details of work in this region are available as a final report: Bristol Bay-Alaska Peninsula region, Overview of 2004-2007 geologic research: DGGS Report of Investigations 2008-1. Photo by Paul Decker, Alaska Division of Oil & Gas.

State of Alaska
Department of Natural Resources
Division of Geological & Geophysical Surveys
February 2009

STATE OF ALASKA
Sarah Palin, *Governor*

DEPARTMENT OF NATURAL RESOURCES
Tom Irwin, *Commissioner*

DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS
Robert F. Swenson, *State Geologist and Director*

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Anchorage, Alaska 99503

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333 Willoughby Avenue
Juneau, Alaska 99811-0571

Publication of this report is required by Alaska Statute 41.08.

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Commissioner's Foreword

I am pleased to present the Division of Geological & Geophysical Surveys (DGGS) Annual Report documenting 2008 as another eventful and productive year. The information contained in this report is clear evidence that work being accomplished at DGGS is critical for the State of Alaska to responsibly develop the vast resource base, keep our citizenry safe from natural hazards, and help ensure a vibrant State economy for the next generation of Alaskans. The staff at DGGS work hard to provide unbiased scientific information on geologic resources and natural hazards that is critical in helping facilitate responsible development of Alaska's rich resource endowment. Of the many issues facing the division, assessing energy resources in both the industrial and consumer sectors, and providing science-based information on natural hazards that can have severe affects on the state's critical infrastructure and population, are top priorities. For example, major projects in the foothills of the Brooks Range, and within the sedimentary basin of the Cook Inlet, are laying the groundwork for the next phase of natural gas exploration that will help alleviate the high cost of in-state energy, as well as provide long-term revenue to the state. Additionally, the coming years will challenge the division to provide pertinent information on inevitable environmental change in Alaska. Our economic future and the well-being of our social fabric depend on important decisions being made today, and I assure you that the staff at DGGS, as well as at DNR, is fully dedicated to making sure that all natural resource policy decisions are based on sound science and objective data.

From the three active volcanoes we observed this summer out on the Aleutian Chain to the North Slope oilfields, and from the majestic fjords in Southeast Alaska to the mineral-rich mining districts of the Seward Peninsula, DGGS is involved in acquiring and disseminating geologic information that will help keep the state moving forward on a safe and economically sustainable path. Please join me in recognizing the staff at DGGS for another banner year. I encourage Alaskans to remain engaged in the protection and development of your resources, and to continue involvement in determining the future of this great state.

Tom Irwin, Commissioner, Department of Natural Resources

Director's Foreword

I believe it is very important that we all periodically take pause in life's pleasures, and count the many blessings that surround us every day here in Alaska. We live in a world that can be filled with uncertainty, strife, fear, greed, and myriad other negatives that can consume our thoughts and dominate our (re)actions, if we allow ourselves to focus on them. The current list of potential worries can be long and overwhelming, so it is crucial that we remember how seldom humans correctly predict the future, and that both natural and economic disasters much worse than the 'forecasters' are predicting today have always been overcome through diligence of community and perseverance of the human spirit. We should never completely ignore potential difficulties, nor scoff at the chance of change; rather, providing and seeking facts, not fear-based rumors, and resisting the temptation of taking shortcuts through complex problems will be the cornerstones of a relatively stable path to the future.

The staff here at DGGS work very hard at providing unbiased scientific information that is needed for the sound policy decisions that will help us stay on that path. The information that emanates from our work can, at times, be perceived as controversial, but the Alaska public can be assured the data is of the highest quality and absent political or special-interest influence. Our talented teams of scientists work on a number of geologic issues of critical importance to the state. We are leading, or are involved in, projects with wide-ranging topics that address energy resource potential in Alaska from the industrial export to local consumptive scales; solid minerals assessments that will help the State identify our resource endowment in precious minerals to facilitate the emerging paradigm shift in global energy; and natural hazards assessments crucial to adapting to environmental change, securing public safety, and protecting the State's investments in infrastructure.

The year 2008 was very exciting at DGGS with a second year of record activity in the minerals sector that tested our Minerals Resources Section in providing the necessary data and expertise to facilitate responsible industry exploration and development. Continued change and record commodity prices in the energy sector kept our Energy Resources Section in high gear in many areas of the state, and across conventional resource boundaries. Continued infrastructure development in areas with high geologic hazards risk challenged our Engineering Geology and Volcanology sections to provide the vast amounts of geologic hazards and construction materials information needed for permitting and pre-construction planning. High demand for data distribution on our web-based database attests to the robustness of our system and skills of Communications staff. Finally, the near ubiquitous public realization of potential environmental change associated with a changing global climate has affected nearly every sector of the survey's responsibilities. Public education and presentation of objective scientific information will be important as we move forward into an uncertain but secure future.

I strongly encourage you to read the program descriptions included in this report, and I welcome any feedback you might have. You will readily see that your Alaska Division of Geological & Geophysical Surveys is meeting many of the challenges that face all Alaskans by providing unbiased geologic information to make sound, science-based policy and development decisions. We will remain diligent in this effort, and will help to ensure Alaska remains prosperous, safe, and environmentally sound—well into the future.

Robert Swenson, State Geologist, Division of Geological & Geophysical Surveys

DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS
ANNUAL REPORT 2008

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 (DGGS) 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 current name and mission of the Division were established 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

Ten 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, 2003–January 2005
Mark D. Myers, February–October 2005
Robert F. Swenson, November 2005–present

By statute the State Geologist serves as the Director of the Division of Geological & Geophysical Surveys in 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 geologic community and professional societies within Alaska. A department order in 2002 formalized a process whereby the Geologic Mapping Advisory Board oversees evaluation of candidates and provides a list to the Commissioner. The qualifications and responsibilities of the State Geologist and the mission of DGGS are defined by statute.

STATUTORY AUTHORITY

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.

Sec. 41.08.030. Printing and distribution of reports. The state geologist shall print and publish an annual report and such other special and topical reports and maps as may be desirable for the benefit of the State, including the printing or reprinting of reports and maps made by other persons or agencies, where authorization to do so is obtained. Reports and maps may be sold and all money received from these sales shall be paid into the general fund. (§ I ch 93 SLA 1972)

LOCATION

The Division's administrative headquarters and personnel 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 35 permanent full-time professional and support personnel, a Director, Deputy Director, and five student interns.

DGGS operates the Alaska Geologic Materials Center in Eagle River, Alaska, staffed by two professional geologists and a student intern. DGGS also administers the 11-member Alaska Seismic Hazards Safety Commission.

Division of Geological & Geophysical Surveys offices in Fairbanks

Geologic Materials Center in Eagle River

ORGANIZATION

DGGS is one of eight divisions and five offices in the Alaska Department of Natural Resources. Under the overall administration of the Director's Office, the Division of Geological & Geophysical Surveys is organized into five sections and the Geologic Materials Center (fig. 1). The Division also administers the Alaska Seismic Hazards Safety Commission.

L TO R: April Woolery, Rod Combellick, Rhea Supplee, Bob Swenson, Vickie Butherus

The **Director's Office** provides strategic planning for the Division's programs to ensure that DGGS is meeting the needs of the public under 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.

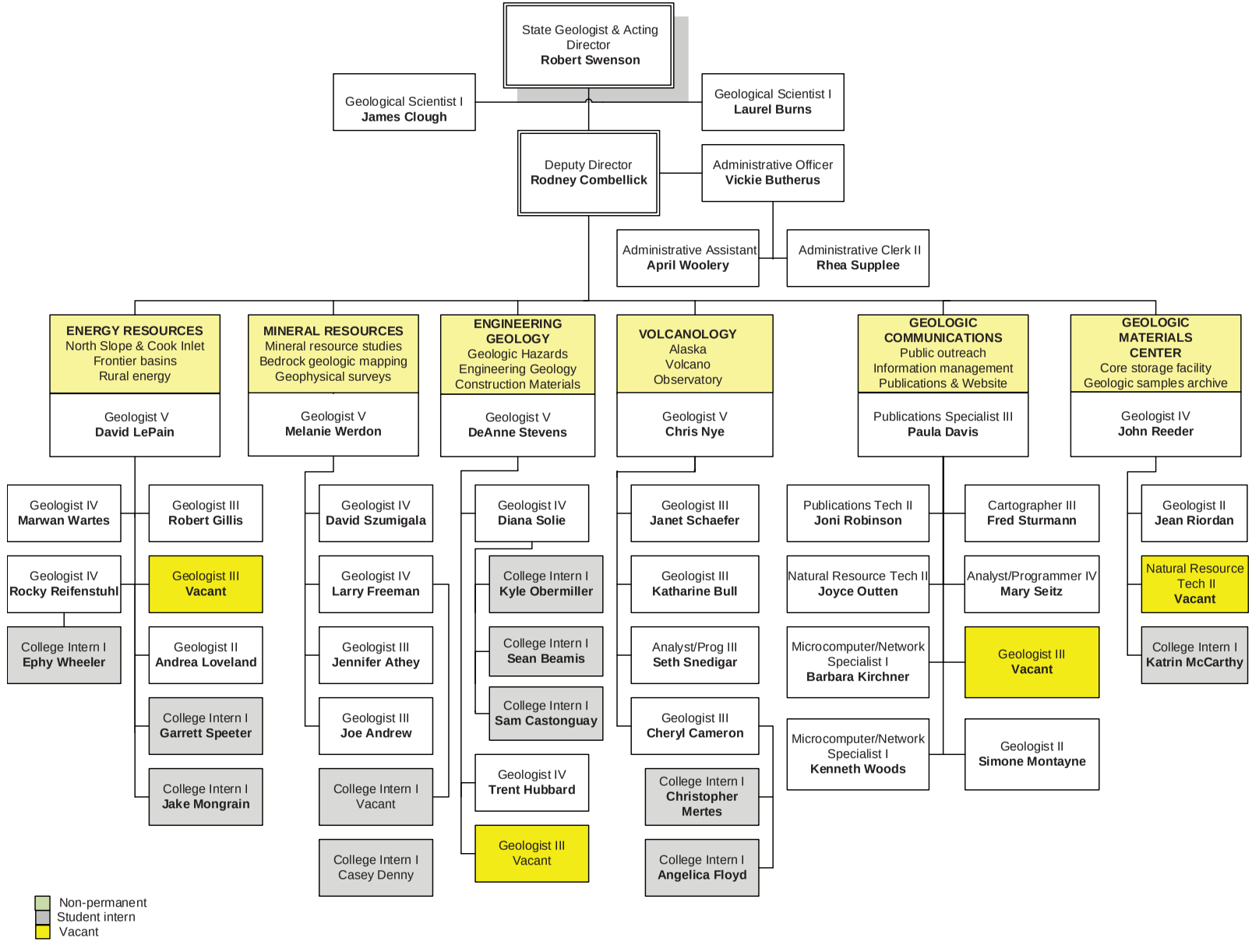
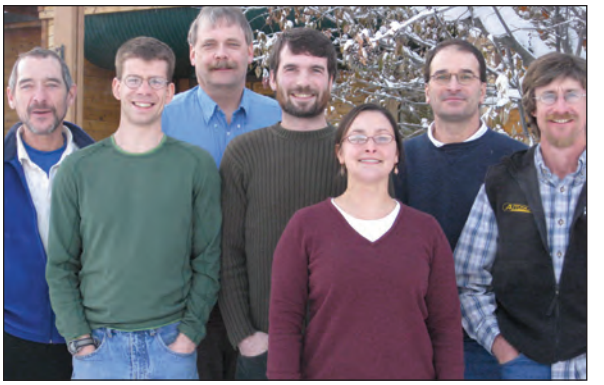


Figure 1. *Organizational chart for the Alaska Division of Geological & Geophysical Surveys.*

The **Energy Resources Section** generates new information about the geologic framework of frontier areas that may host undiscovered oil, gas, coal, or geothermal 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 seeks to improve the success of state-revenue-generating commercial oil and gas exploration and development and to identify local sources of energy for rural Alaska villages and enterprises.



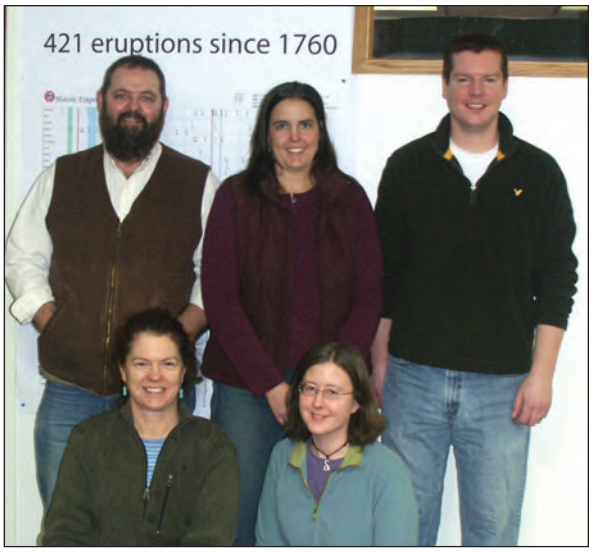
L TO R: Rocky Reifenstuhl, Jake Mongrain, Jim Clough, Marwan Wartes, Andrea Loveland, Dave LePain, Bob Gillis

BACK L TO R: Larry Freeman, Dave Szumigala, Joe Andrew, Melanie Werdon
FRONT L TO R: Laurel Burns, Jen Athey, Casey Denny

The **Mineral Resources Section** collects, analyzes, and makes available information on the geological 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. These data help to encourage mineral exploration in Alaska and aid in the state management of mineral development, which provides employment opportunities and revenue for Alaska's citizens.

The **Engineering Geology Section** collects, analyzes, and compiles geologic data useful for engineering and hazard risk-mitigation purposes. Surficial-geologic maps portray the distribution of unconsolidated surficial geologic materials and provide information on their engineering properties and potential as construction-materials sources. Studies of major geologic hazards such as earthquakes, active faults, and tsunamis result in reports outlining potential hazards in susceptible areas. The section advises other DNR divisions and state agencies regarding potential hazard risks to proposed developments and land disposals.

L TO R: Diana Solie, Kyle Obermiller, Trent Hubbard, De Anne Stevens



Back L to R: Chris Nye, Janet Schaefer, Seth Snedigar
Front L to R: Kate Bull, Cheryl Cameron

The **Volcanology Section,** established in 2007, focuses on processes and hazards associated with the more than 50 active volcanoes in Alaska. The section contains the DGGS portion of the Alaska Volcano Observatory (AVO; an interagency collaboration between the U.S. Geological Survey, University of Alaska Fairbanks Geophysical Institute, and DGGS). Volcanology Section staff conduct geologic studies of active volcanoes to estimate their future eruptive potential and behavior, thus aiding in mitigating volcanic-hazard risks. Results of these studies are released as maps and reports. The section also creates and maintains a large, public web-accessible database of information on volcano history and current activity (www.avo.alaska.edu) as well as an internal website providing communication, record keeping, and data sharing within AVO. In 2008 the section became heavily involved in geothermal resource issues, providing information to other agencies and the private sector and participating in state activities leading up to the geothermal lease sale at Mt. Spurr.

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 Alaska-related geologic information. Increased use of computer technology is resulting in faster preparation of maps and reports and a wider awareness of Alaska geologic information available from DGGS. This section manages the design, implementation, and maintenance of a computer-hosted database for the Division's digital and map-based geological and geophysical data, as well as the Division's website (www.dggs.dnr.state.ak.us) and the Alaska Seismic Hazards Safety Commission website (http://www.dggs.dnr.state.ak.us/seismic_hazards_safety_commission.htm).

Back L to R: Ken Woods, Susan Seitz, Joni Robinson
Middle L to R: Simone Montayne, Joyce Outten, Bobby Kirchner, Fred Sturmann
Front: Paula Davis

John Reeder and Jean Riordan

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 or processed samples generated from privately funded analyses of the geologic materials stored there must be donated to the GMC database.

The **Alaska Seismic Hazards Safety Commission** is charged by statute (AS §44.37.067) to recommend goals and priorities for seismic risk mitigation to the public and private sectors and to advise the Governor and Legislature on policies to reduce the state's vulnerability to earthquakes and tsunamis. The Commission is administered by DGGS and consists of 11 members appointed by the Governor from the public and private sectors for three-year terms. The Commission produces a separate annual report to the Governor and Legislature and has its own website at http://www.dggs.dnr.state.ak.us/seismic_hazards_safety_commission.htm.

RELATIONSHIPS WITH OTHER STATE AGENCIES

DGGS provides other DNR agencies with routine analyses and reviews of various geologic issues such as geologic-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's interaction with the Land Records Information Section in the DNR Support Services Division continues to increase as more geologic data are compiled and organized in digital format amenable to merging with other land information. The DGGS Energy Resources Section works closely with geologic personnel in the Division of Oil and Gas (DOG) on issues related to energy resources and in providing geologic control for the subsurface oil-related geologic analyses conducted by DOG. Each year DGGS prepares an annual report on the status of Alaska's mineral industry in cooperation with the Office of Economic Development in the Department of Commerce, Community & Economic Development. The Engineering Geology section works closely with Division of Homeland Security & Emergency Management in the Department of Military and Veterans Affairs to evaluate hazards, develop scenarios for hazards events, and prepare the State Hazard Mitigation Plan. Additionally, the Engineering Geology section participates in the Alaska Coastal Management Program to advise on geologic hazards issues and review coastal district plans and project applications. DGGS also evaluates resource potential around the state that may provide viable alternatives for energy development in rural Alaska.

Funding to support work requested by other DNR agencies mostly has been drawn from DGGS's 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.

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, DGGS participates in a federally funded cooperative program to develop tsunami-inundation maps for coastal communities. In Kodiak, Homer, and Seldovia, the first communities 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 with Seward and Sitka for the next tsunami-inundation maps to be generated by this program. The Engineering Geology section has also worked closely with several communities to develop a field-geoscience outreach program for middle- and high-school students in rural Alaska. Similarly, the Energy Resources section has worked closely with rural communities to help assess potential local energy resources.

RELATIONSHIP WITH THE UNIVERSITY OF ALASKA

DGGS has had a long and productive professional association with geoscientists and students in various departments of the University of Alaska. University of Alaska faculty work as project team members on DGGS projects and provide special analytical skills for generating stratigraphic, structural, geochemical, and radiometric-age data. Collaborative research projects and program oversight help provide both organizations with focused work plans that complement one another.

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. Some graduate students are able to apply their DGGS intern work to their thesis projects. DGGS and the University make frequent use of each other's libraries and equipment.

RELATIONSHIPS WITH FEDERAL AGENCIES

DGGS often has 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, in the past, DGGS has also engaged in cooperative programs with the U.S. Minerals Management Service (MMS), National Aeronautics and Space Administration (NASA), and the National Science Foundation (NSF). DGGS receives some federal funds from matching grants for which the Division must compete nationally with other organizations on a yearly basis. DGGS has 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. Although DGGS has historically been very successful in receiving federal grants and appropriations, the process is highly competitive and these funds are therefore project specific or complementary to state-funded programs and do not replace state General Fund money. Federal funding is pursued only for projects that are needed to advance the division's statutory mission.

Three ongoing cooperative programs with federal agencies have provided support for key elements of the DGGS mission in recent years. One is the Alaska Volcano Observatory (AVO), a partnership established in 1988 and consisting of USGS, DGGS, and the University of Alaska Fairbanks Geophysical Institute. The USGS funds and administers the program for the purpose of providing a coordinated approach to mitigating volcano hazard risks to the public, the state infrastructure, and air commerce. A second longstanding cooperative federal program is the STATEMAP component of the National Cooperative Geologic Mapping Program, established by Congress in 1992 and also administered by USGS. STATEMAP provides matching funds for geologic-mapping projects according to priorities set by the Geologic Mapping Advisory Board (see below). A third major federal program is the Minerals Data & Information Rescue in Alaska (MDIRA) program, established by Congress in 1997. DGGS has completed numerous MDIRA projects, administered by USGS and BLM, for the purpose of recovering, indexing, archiving, and making publicly available minerals information at risk of becoming lost due to downsizing of public and private minerals-related programs.

ALASKA GEOLOGIC MAPPING ADVISORY BOARD

The Alaska Geologic Mapping Advisory Board guides DGGS in pursuing its goal of providing earth science information to the Alaska public. A number of prominent geologists and community leaders, 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 should 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 and legislative support for statewide geologic resource inventories and engineering geology programs.

The board held its first meeting in Fairbanks on October 22, 1995, and meets usually 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:

Irene Anderson
Bering Straits 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.

Greg Beischer
Mill Rock Resources, President
Greg Beischer is a geologist and mining engineering technologist with many years of experience in the industry, specializing in exploration, development, and management of mineral resources.

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.

Peter Haeussler
U.S. Geological Survey, representing the federal government, earthquakes hazards, and mapping interests.
Peter Haeussler is a geologist in the Anchorage office of the USGS Geologic Division, specializing in earthquake hazards, tectonics, and geologic mapping.

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.

Tom Homza
Shell Exploration and Production, Alaska
Tom Homza is a Staff Geologist at shell with more than 10 years experience in oil and gas exploration and development in Alaska and represents the oil industry in mapping advice and structural interpretation.

Paul Layer
University of Alaska Fairbanks Department of Geology and Geophysics, 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.

David Stanley
Alaska Department of Transportation & Public Facilities (DOTPF), representing state government and the engineering geology and geotechnical community
David Stanley is Chief Engineering Geologist of the DOTPF, overseeing geotechnical studies in support of development and maintenance of the state's highways and airports.

FY2008 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 FY2008 the Division successfully performed geological and geophysical mineral inventory mapping, generated new geologic data to support energy exploration, conducted hazard investigations, performed geologic and hazards studies on active volcanoes, and streamlined geologic data archival and dissemination.

MAJOR ACCOMPLISHMENTS IN FY2008

Energy Resources

- Conducted geologic mapping, structural, and stratigraphic studies on the **North Slope** in collaboration with the Division of Oil & Gas and U.S. Geological Survey, collecting geologic data for evaluating the hydrocarbon potential of the Brooks Range foothills.
- Prepared a **field tour for oil and gas industry geologists** at Happy Valley camp to present new technical results bearing on the petroleum geology of northern Alaska. The tour included a two-day geologic tour of field localities between the Ivishak and Sagavanirktok rivers, illustrating relationships that are key to oil and gas exploration.
- Published a multi-chapter volume addressing key geologic relationships in the central **Sagavanirktok Quadrangle** relevant to oil and gas exploration.
- Conducted structural and stratigraphic studies in **Cook Inlet** in collaboration with the Division of Oil & Gas, collecting data relevant to assessing the hydrocarbon potential of Cook Inlet basin.
- Conducted a one-day tour for industry and government geologists examining potential oil and gas reservoir deposit types along beach bluff exposures on the **Kenai Peninsula**.
- Prepared a multi-chapter volume addressing the geology of **potential reservoir sands in Cook Inlet**.
- Conducted a two-day technical review meeting in Anchorage for government and industry representatives and members of the public to present new data relevant to oil and gas exploration in the **North Slope foothills, Bristol Bay and Alaska Peninsula region, and upper Cook Inlet**.
- Participated in a one-day forum in Anchorage addressing the potential for gas production from **low permeability reservoirs in Alaska**.
- Prepared a final report summarizing a three-year field program as part of U.S. Department of Energy and state-funded geologic evaluation of the petroleum potential in the **Bristol Bay and Alaska Peninsula** region.
- Presented new data relevant to oil and gas exploration in the North Slope foothills and upper Cook Inlet to government and industry representatives at the annual meeting of the **American Association of Petroleum Geologists**.

Mineral Resources

- Published ***Alaska's Mineral Industry 2006*** (Special Report 61), an authoritative annual report of statewide mineral exploration, development, and production, in collaboration with the Alaska Department of Commerce, Community, and Economic Development.
- Completed draft bedrock geologic map of 189 square miles of the **Northeast Fairbanks** airborne-geophysical survey tract, to be published in FY2009.
- Completed draft **bedrock geologic map** of 453 square miles of the proposed **Gas Pipeline Corridor** airborne-geophysical survey tract between Delta Junction and Dot Lake, interior Alaska.
- Published **geochemical data reports** for the **Richardson District** (interior Alaska), **Council area** (northwestern Alaska), **Alaska Highway Corridor**, and **Northeast Fairbanks area**.
- Released **airborne geophysical surveys** of 250 square miles of mineral-interest lands in the **Western Fortymile area** in eastern Interior Alaska.
- Released **airborne geophysical surveys** of 715 square miles of mineral-interest lands in the **Styx River area**, southwest Alaska.
- Initiated **airborne geophysical surveys** of 405 square miles of mineral-interest lands in the **Mentasta–Slana area**, eastern Alaska Range.

Engineering Geology and Hazards

- Completed **geologic mapping and geohazards evaluation investigations of more than 700 square miles along the Alaska Highway** between Dot Lake and Tetlin Junction, as the second part of a continuing study of a proposed natural gas pipeline corridor. Field work included surficial- and bedrock-geologic mapping, permafrost investigations and evaluation of potentially active faults near and within the corridor. Analyses and report writing are in progress.

- Initiated a 1:63,360-scale **surficial-geologic mapping project in the Sagavanirktok Quadrangle** in cooperation with the Energy Resources Section. Of a total map area of 1,212 square miles, 835 square miles of surficial geology will be mapped at a reconnaissance level and 377 square miles centered on the Dalton Highway will be mapped at a higher level of detail. Preliminary air photo interpretation was conducted in April and May 2008 and field work was completed in June and July 2008. Compilation of the map is currently in progress.
- Completed 188 square miles of **surficial-geologic mapping in the Northeast Fairbanks airborne-geophysical survey tract** in cooperation with the Mineral Resources Section. Map has been reviewed and final publication is anticipated in early 2009.
- In collaboration with the University of Alaska Fairbanks and University of Wisconsin Madison, completed the **final phase of NSF-funded work on MapTEACH** (Mapping Technology Experiences with Alaska's Cultural Heritage). The 4-year pilot project developed an educational program for middle- and high-school students in Alaska emphasizing hands-on experience with geospatial technology (GPS, GIS, and remote sensing imagery) in conjunction with traditional activities and geoscience. MapTEACH has now been adopted by the University of Alaska Geography program, which has embraced it as its "flagship K–12 outreach program."
- Participated in the **Ninth International Conference on Permafrost**, held in Fairbanks June 29–July 3, 2008. As part of the conference, section members co-led a field trip to the Seward Peninsula, presented a local Fairbanks field trip site, and coordinated and edited a multi-author local field trip guidebook.
- Supported the **Alaska Coastal Management Program** (ACMP) by reviewing Coastal Project Questionnaires and advising project review coordinators on natural hazards issues.
- Supported the Alaska Division of Oil & Gas by writing, revising, and updating **natural hazards reports for lease sale documents**.
- Provided administrative support for the **Alaska Seismic Hazards Safety Commission**.

Volcanology

- Assisted (with Alaska Volcano Observatory partner agencies) in **monitoring and reporting** on the 2007 eruption of Pavlof Volcano, ongoing eruptions of Cleveland and Veniaminof volcanoes, and waning activity at Fourpeaked volcano.
- Published a report and map of field observations relating to the 2005 crater lake **acid-drainage event at Chiginagak volcano**.
- Conducted annual water quality monitoring at **Mother Goose Lake and the King Salmon River** by collecting water samples and measuring the pH of acid water draining from Chiginagak volcano's crater lake. Acidification of these drainages has eliminated once-robust salmon runs since 2005.
- Co-led and managed a helicopter- and fixed-wing supported field camp on **Augustine Volcano**, involving more than 30 scientists and a complex schedule of field studies as follow-up to the 2006 eruption.
- Maintained the **Alaska Volcano Observatory (AVO) internal and external World Wide Web sites**, including designing and implementing new automated ways to deliver daily and weekly notices of volcanic activity, implementation of internal communication tools, and updating the public site. A new interactive map showing current volcano monitoring data has also been added to the public page.

Geologic Information Management and Delivery

- **Produced 60 new reports,** including 39 Geophysical Reports, 9 Preliminary Interpretive Reports, 7 Raw Data Files, 1 Guidebook, 1 Special Report, 1 Information Circular, 1 Newsletter issue, and 1 Annual Report.
- **Sold 592 reports and distributed 2,035 complimentary copies of reports** at conferences, to teachers, and to fill general requests. Public contacts for the year included 134 walk-ins, 8 fax orders, 73 phone calls, 37 e-mail requests, and 28 mail requests.
- Logged more than **523,000 visits on the DGGS Website** from users viewing information on Alaska's geology and downloading geologic and geophysical reports and data.
- Launched a new **Digital Geologic Data Distribution application**, an internal web application that allows DGGS to post geospatial data on the web for direct public access. Sixty-three geologic datasets are now available on the web to download free of charge, and more are being added. Since the application went into production in November 2007, there were 408 dataset downloads from the DGGS website in FY2008.
- Upgraded the **DGGS website's online publications pages** including helpful breadcrumbs, web page titles, and advanced search improvements to

provide users more efficient tools for retrieving geologic and geophysical information.

- Added documents from DGGS's collection of unpublished **legacy paper maps** to the newly cataloged collection. The original collection comprised more than 5,000 unsorted sheets authored from 1918 to the present. The resulting collection has been pared down to approximately 2,000 sheets, each of which has been bar coded, cataloged, and assigned a specific location in the DGGS legacy data library to facilitate future recovery for reference by DGGS employees and the public.
- Recovered approximately 15 pallets of **valuable unarchived rock samples**, collected in support of past geologic field observations and interpretations. These samples, collected between about 1950 and 1990, were nearly lost due to deterioration of their labels and poor storage conditions. The rocks were cataloged, relabeled, and re-boxed so that they could be archived for public use at DGGS's Alaska Geologic Materials Center in Eagle River.
- Initiated development of a new **Geologic Materials Center inventory database** to integrate the GMC inventory data into DGGS's Oracle database and make the inventory publicly available on the web.
- Presented an **Introduction to GIS class** at the University of Alaska, Department of Engineering as part of DGGS's ongoing efforts in geoscience outreach and education.
- Salvaged **legacy GIS data** files dating back to 1994 that were corrupted and unusable due to problems with data storage. The recovered data were converted and used to recreate map layers in modern GIS format. Metadata was completed, and this data set will be added to the list of available digital data on the DGGS website.
- The **DGGS public reference library** expanded as a result of the closing of the U.S. Bureau of Land Management's John Rishel Mineral Information Center in Juneau. Much of the center's material was sent to DGGS to incorporate into the library. Funding through the Minerals Data & Information Rescue in Alaska (MDIRA) program facilitated the cataloging of much of the DGGS collection by librarians from the UAF Geophysical Institute's Keith Mather Library.
- The Information Technology group made several **upgrades to the computer/server network** that is used by all of the DGGS staff. Upgrades included new disk storage space for the file server; a new Uninterruptible Power Supply (UPS), adequate for all of the servers and other IT infrastructure; a backup server for weekly backups of every computer in the building; Oracle software upgrade; conversion of the telephone system to Voice over Internet Protocol (VoIP); and installation of a permanent wireless projector in the division conference room.

Geologic Materials Center

- Hosted **497 visitations to the Alaska Geologic Materials Center** (GMC) in Eagle River by industry, government, and academic personnel to examine rock samples and processed materials. These visitations helped generate 1,343 processed oil and gas related microscope slides and 12 hard-rock mineral and oil and gas technical data reports.
- Received **rock samples for 36 new oil and gas wells**, representing 192,986 feet of well samples, from the Alaska Oil and Gas Conservation Commission.
- Received **mineral core for 5 mineral core holes of 2 prospects**: the nickel–copper–cobalt Funter Bay prospect near Juneau, and the Rua Cove massive sulfide prospect in Prince William Sound.
- Received a total of **15 pallets of surface samples** for Alaska from the U.S. Bureau of Land Management and from DGGS geologists.
- Completed a detailed inventory of the **Phillips Oil Company well sample rock collection** of Alaska at the Alaska GMC that was originally held by American/Canadian Stratigraphic Company in Anchorage.
- Completed a detailed inventory of the **Union Oil Company of California well sample rock collection** of Alaska at the Alaska GMC that was originally held in the basement of their Anchorage office.
- Completed a detailed inventory of the Alaska **Division of Geological & Geophysical Surveys surface rock collection** at the Alaska GMC that predates the materials received from DGGS during FY08.
- Created a working **ONEGMC database** combining all processed and unprocessed hard-rock mineral core and oil and gas well samples from 26 different GMC collections into a single, searchable inventory system.
- Assisted DGGS with definition and system analysis for a **future planned web-accessible sample-inventory database**.

KEY ISSUES FOR FY2009–2010

THE CHANGING FACE OF LOCAL ENERGY SUPPLY AND CONSUMPTION

- Sustained high energy prices have had a significant impact on the economies of rural Alaska and threaten the viability of rural infrastructure.
- Many remote areas of the state lack sufficient geologic information on potential alternate forms of energy such as shallow natural gas, coal, geothermal, and conventional gas.
- Misinformation about viable alternate energy sources is rampant and many expensive mistakes can be avoided by getting accurate information into the hands of the local governments and decision makers.
- The Legislature will act in the coming year to help citizens weather the difficult financial burdens associated with fuel costs in rural Alaska. Unfortunately, neither the state nor the public is prepared for the demand for data, expertise, and reputable contractors that will be needed to perform the necessary analyses and research.
- Dramatically changing the state's energy supply will be a non-trivial exercise. Providing money to make changes is a first important step, however there must be oversight and monitoring of projects to avoid the substantial mistakes of the past. This is a problem that will not be solved by pouring state funding into a trough and yelling, "Come and get it."
- The Alaska Energy Authority has been tasked with distributing state funds, by the way of grants, to begin assessing and developing sustainable forms of energy in all corners of the state. DGGS will be intimately involved in reviewing the proposals for resource existence, methodology, and data review. DNR will be tasked with the substantial job of regulating the hundreds of projects that have the real potential to significantly impact the state's natural resources.
- DGGS will be challenged to provide pertinent and timely data on numerous fronts, and is requesting additional capital project funds to begin a long-term program that addresses the occurrence of locally available energy sources and makes that data available to those that are in need of it.

RESPONSE TO DATA NEEDS FOR ADAPTATION TO A CHANGING ARCTIC CLIMATE

- Alaska will, over the coming years, be a national focal point for indications and impacts of climate change. Our ability to provide reliable, unbiased data for the development and evaluation of emerging policy and statute changes will be very important for achieving reasonable, long-range planning and risk mitigation. We will continue to collect, and make available to the public, geologic and hazards data needed to help mitigate effects of hazards and adapt to the changing environment.
- There are many areas where geologic information will be needed. Most important, these data will be required in areas of coastal development and critical infrastructure where ground settlement from thawing permafrost, increased erosion and landslide hazards, and changes in hydrologic systems (both surface and subsurface aquifers) will be prevalent.
- Historically the state has relied on site-specific hazards analyses related to ongoing development or permit approval. The recognition of significant change across the arctic will require that regional baseline data be gathered and made available to communities and local planners so that mitigation and new development can progress with physical and environmental change in mind.
- Continued population growth and development in Alaska will continue to encroach on areas with heightened geohazard risk.
- DGGS will be tasked with acquiring geologic data, producing maps, and identifying risks—information that can be used in both short- and long-term planning. In some cases it will be critical to have this data available in crisis situations.
- DGGS will work with many other agencies (with a wide range of mandates) in a coordinated effort so that the most important needs are addressed, and redundancy is minimized.
- The key challenge will be in the prioritization of the areas, as there is much more need for data than the availability of personnel and funding to acquire it.

UPDATING AND IMPROVING THE ALASKA GEOLOGIC MATERIALS CENTER

(See also the appendix of this report)

- A repository of rock core, samples, and data is critical for any state (or country) that relies on resource development as a key component of its economy.

- The Geologic Materials Center (GMC), located in Eagle River, is Alaska's rock data repository and is the "first stop" for any industry or academic researcher who is attempting to identify and understand the complex geology of the numerous resource-rich areas throughout Alaska.
- Providing efficient and comprehensive access to these data is critically important for viable exploration programs, for both seasoned Alaska explorers and new companies that are trying to identify potential exploration areas.
- Although the current condition of the GMC is being maintained, the facility is more than 150 percent over its designed sample-storage capacity, and is very poorly designed to handle the regular and frequent requests for reasonable access to the material.
- The GMC currently utilizes 60 portable containers as temporary storage facilities for recent sample acquisitions. These shipping containers are unlighted, unheated, and house thousands of feet of core, some of which will disintegrate with repeated freeze-thaw cycles. It is important to note that this collection represents hundreds of millions of dollars of acquisition and preservation costs and is in significant risk of damage or loss.
- The core and sample observation areas are essentially unusable for confidential work and examination of more than a few feet of core length. An exploration company's ability to keep their activities confidential is critical to exploration success in a fiercely competitive environment. Often the core must be taken off-site for substantial projects, creating a significant security threat to the unique core, and an expensive alternative for the exploration company. All of these factors could result in a reluctance by users to make use of the facility because they must go through the onerous effort of transporting and unnecessarily handling the material at risk.
- A facility concept study, funded through a special federal appropriation, was finished in July 2006. The study identified the most feasible options for design and provided cost estimates for various configurations. A brochure summarizing the findings of this study is presented in the appendix of this report.
- A significant challenge for DGGS over the near term will be to convince the public, lawmakers, and government officials of the importance of upgrading this facility and providing the funding necessary to keep this critical data source safe and accessible. We have now initiated a multi-agency task force that will finalize the site selection and identify public funding sources and key legislators to support the project.

SUSTAINED HIGH-LEVEL COMMODITY PRICES

- Although this is very good news for State revenue as a whole, increased price structure in most natural resource commodities presents a challenge for DGGS to meet demands for geologic information.
- Loss of personnel to industry and retirement remained a key challenge in FY09, and will likely continue into the foreseeable future.
- Dramatic increases in minerals and oil and gas exploration efforts by independent industry puts a noticeable strain on all facilities and programs. Our effort to provide critical geologic data to these entities will be challenged as more and more end-users of our products demand quicker and more comprehensive response. The main challenges will arise from a static state budget and our ability to plan for the rapidly changing needs of the resource development community, and to gather the required field information in the face of rising operating costs.
- Spikes in the exploration cycle also create a situation where high-paying jobs become abundant, and opportunities for experienced geoscientists become commonplace. A significant challenge for DGGS will be our ability to attract and retain key personnel in this very competitive environment.

INFRASTRUCTURE PROJECTS

- Development of Alaska's vast resource base requires reasonable access to world markets. Providing geologic data for infrastructure maintenance and development will remain a key challenge for DGGS.
- The AGIA pipeline will require vast amounts of construction materials information and geologic hazards data to allow timely and safe design and development. DGGS is currently acquiring those data, but will need to accelerate the current pace to supply the needed maps and information.
- Continued arctic warming will undoubtedly increase maintenance requirements on much of Alaska's current roads and transportation corridors. Identifying geologic hazards and areas prone to failure will be needed to mitigate this change. Increased materials requirements will likewise strain DOT's ability to address this issue. DGGS will work with other state agencies to provide modern analytical techniques for this work.

DGGS FY2009 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 FY2009 DGGS program is focused on projects designed to foster the creation of future Alaskan natural-resource jobs and revenue and to mitigate adverse effects of geologic hazards. For the foreseeable future, much of the economy will continue to depend on developing the state's natural resources. Within that future, 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. Both resource development and hazard risk mitigation depend heavily on the availability of reliable geologic information.

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 Commerce, Community & Economic Development, Department of Transportation & Public Facilities, Division of Homeland Security & Emergency Management, and the Federal Emergency Management Agency. DGGS geologists provide geologic and geophysical information to assist prospectors, mineral, oil, and gas explorationists and others to explore for, discover, 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 hazard risks. 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. Through its Geologic Materials Center in Eagle River, DGGS also provides access to physical samples collected by private companies and government agencies.

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. These data are archived in various locations offering various levels of storage capacity, quality, and accessibility. The budget shortfalls 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 geologic 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

FY09 DIVISION EXPENSE BUDGET
(estimated expenses in thousands of dollars)

Program	General Fund	CIP	Federal Receipts	Interagency & Program Receipts	Total
Energy Resources	891.7	316.7	54.8	141.2	1,404.4
Mineral Resources	1,055.5	368.5	187.6	5.0	1,616.6
Engineering Geology	523.0	714.8	0.0	72.7	1,310.5
Volcanology	0.0	0.0	1,103.7	0.0	1,103.7
Geologic Communications	677.0	463.0	29.0	10.0	1,179.0
Geologic Materials Center	272.5	40.0	130.0	55.0	497.5
Administrative Services	438.4	0.0	0.0	0.0	438.4
Seismic Hazards Safety Commission	10.0	0.0	0.0	0.0	10.0
Total by funding source	**3,868.1**	**1,903.0**	**1,505.1**	**283.9**	**7,560.1**

needs of its intended users. A liaison committee comprising representatives from the Alaska Miners Association, Alaska Native corporations, University of Alaska, Alaska Department of Natural Resources, and independent mining industry consultants guides the implementation of the Alaska minerals data rescue efforts through a federally funded program entitled Minerals Data and Information Rescue in Alaska (MDIRA). DGGS projects supported in whole or in part by this program have been undertaken by the Mineral Resources and Geologic Communications sections. DGGS's MDIRA projects are in their final year of funding and will be completed by September 2009. In the FY2009 Program Summaries that follow, the two remaining MDIRA projects are indicated by an asterisk (*).

PROGRAM SUMMARIES

STATE GEOLOGIST/DIRECTOR

The Director's Office provides leadership and coordination for the activities of the Division through the State Geologist/Director, Deputy Director, and administrative staff.

OBJECTIVES

1. Provide executive leadership for the Geological Development Component of DNR's program budget and act as liaison between the Division and the DNR Commissioner's Office, other state agencies, Legislature, Governor's Office, and local, federal, and private entities.
2. Stimulate exploration, discovery, and development of the geologic resources of the state through implementation of detailed geological and geophysical surveys as prescribed by AS 41.08.
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 energy- and minerals-related reference cores and samples.

TASKS

- Prepare annual Division funding plan including Alaska General Fund base budget, Capital Improvement Project budget, interagency programs, and federal initiatives.
- Inform Alaska state legislators, Governor's Office, Alaska federal delegation, and the public 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, natural gas, coal, and geothermal resources. As both State and national oil and gas reserves continue to decline, and associated price volatility becomes the norm, it will become exceedingly important that new energy resources are identified in the state to help offset declining conventional reserves and state income. An additional need that must be addressed in the short term is that of identifying affordable energy resources that can be economically developed for smaller local markets. As a consequence, there is a continual need for acquisition and dissemination of fundamental geologic data using modern technology that will enable industry and local governments to better focus exploration efforts on prospective areas beyond the currently producing areas. Recent DGGS stratigraphic studies and geologic mapping in the central and eastern North Slope are stimulating exploration interest in the Brooks Range foothills. This underexplored frontier province appears to be dominantly gas-prone and has the potential to yield additional reserves for the proposed natural gas pipeline. In late FY2008, DGGS resumed stratigraphic studies of an area straddling the Trans-Alaska Pipeline corridor in the Sagavanirktok Quadrangle of the east-central Brooks Range foothills. This area encompasses approximately 600 square miles, and includes stratigraphic and structural elements important to understanding the oil and gas potential of Alaska's North Slope. This work included detailed bedrock-geologic mapping that was partially funded by the federal STATEMAP program, in an effort to provide basic geologic data to support oil and gas exploration in the region.

The Statewide Energy Resource Assessment program has completed an evaluation of potential oil and gas

source and reservoir rocks in the Bristol Bay Basin and Alaska Peninsula region that provides baseline geologic data to better assess the hydrocarbon potential of this frontier area. This 3-year project has generated new geologic information useful for oil and gas exploration on state-owned onshore and 3-mile-limit waters of Bristol Bay Basin and the Alaska Peninsula that were the focus of state lease sales. A final report summarizing findings of this work has been completed and is available on-line from DGGS at http://www.dggs.dnr.state.ak.us/.

Predicted gas deliverability shortfalls in the south-central Alaska market have resulted in a significant increase in exploration interest in the Cook Inlet Basin. With this new interest the exploration focus has shifted from permeable sandstones in structural traps to gas in tight sandstone formations and stratigraphic plays. To stimulate sustained interest, DGGS initiated a multi-year study of this basin in FY2007 to provide relevant high-quality data to help evaluate resource potential of tight formations and stratigraphic traps to stimulate exploration interest. This project focuses on building a robust model of the basin's stratigraphy to help predict the distribution of potential sandstone reservoirs and to provide a better understanding of parameters controlling reservoir quality and producibility. In FY2008 and FY2009 DGGS resumed stratigraphic studies on the Kenai Lowland and in the Tyonek-Beluga River area. Work in the latter area included reconnaissance geologic mapping in a 700 square mile area in anticipation of a geologic mapping project in FY2010 partially funded by the federal STATEMAP program, aimed at clarifying structural and stratigraphic relationships in formations with significant oil and gas potential.

DGGS is also participating in a state and federal government project 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. These gas hydrates have the potential to be an additional source of natural gas that can be produced by conventional methods and will add to the total gas resources available for the proposed natural gas pipeline. In FY2007, DGGS initiated a program to use temperature survey data derived from existing oil and gas wells to evaluate areas of elevated geothermal gradient on the North Slope that adversely affect gas hydrate resources. A database of corrected bottom hole temperatures for selected North Slope oil wells and a regional map showing the modeled data and contoured isotherms of thermal gradient (where data density allows) will be released in February 2008.

The Statewide Energy Resource Assessment program also is collecting new coal quality and stratigraphic data and working to implement a comprehensive statewide coal resource data file as part of an integrated DGGS geologic data management system.

DGGS is participating in a multi-agency effort to inventory Alaska's energy resources. This project includes development of a user-friendly web-based interactive map to display the location, type, and, where applicable, a risk-weighted quantity estimate of energy resources available in a given area or at a specific site. In addition to this effort, DGGS is currently reviewing available information on potential geology-based energy resources for use by rural communities. This work will summarize available relevant information, identify areas of the state where additional information is needed to better understand the actual resource potential, and will be incorporated into the web-based interactive map. The reporting function for this project was recently transferred to the Alaska Energy Authority.

The numerous elements of the Statewide Energy Resource Assessment program are financed from a mixture of funding sources: General Fund, Industry 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. Generate new geologic data that support oil and gas industry exploration in the Bristol Bay Basin and Alaska Peninsula region.
3. Collect new geologic data to stimulate renewed, successful exploration for hydrocarbons in the Cook Inlet Basin.
4. 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 can be made.

FY2009 ENERGY RESOURCES PROJECTS

Detailed project summaries for the following energy resources projects appear in the section *Project Summaries—FY2009*:

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

- Provide written evaluations of mineable coal potential for lease areas in response to requests from Division of Mining, Land and Water.
- 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.

MINERAL RESOURCES

The minerals industry has been a significant and steadfast partner in the economic wellbeing of Alaska since the late 1800s. In more recent times, global demand for strategic minerals is at an all-time high and Alaska's minerals reserves will play a significant role in helping meet that rising demand. The mineral industry, however, has historically been reluctant to commit significant company resources to exploration without sufficient understanding of the geologic framework of their areas of interest. For this reason, and to support responsible stewardship of Alaska's mineral endowment, DGGS conducts geological and geophysical surveys of the most prospective Alaska lands that are open to mineral and other geologic resource development.

Alaska has an accessible state land endowment of more than 100 million acres, much of it selected under the Statehood Act because of perceived potential to host mineral wealth. Currently the overwhelming majority of these lands are not geologically or geophysically surveyed at a sufficiently detailed level, nor 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. Projects of the Mineral Resources section are designed to produce, on a prioritized schedule, the critical new surveys and reports needed to sustain Alaska's mineral industry investments and provide management agencies with information needed to formulate rational management policy.

The Mineral Resources section also shares responsibilities with the Geologic Communications Section in the Division-wide task of implementing a publicly accessible, comprehensive, on-line computerized Alaska geologic information database through implementation of the Minerals Data and Information Rescue in Alaska (MDIRA) program.

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

OBJECTIVES

1. Catalyze increased mineral resource exploration in Alaska's mining districts.

2. Provide DNR, other state agencies, and the public with unbiased, authoritative information on the geologic framework and mineral resources of the state so that rational land policy and investment decisions can be made.
3. Provide, in cooperation with the Department of Commerce, Community and Economic Development, an accurate annual statistical and descriptive summary of the status of Alaska's mineral industry.

FY2009 MINERAL RESOURCES PROJECTS

Detailed project summaries for the following Mineral Resources projects appear in the section *Project Summaries—FY2009*:

* MDIRA-supported project (see p. 14)

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, tsunamis, and landslides help to forecast the likelihood of future major events and the severity of hazards associated with them. In addition to General Funds, some elements of the Engineering Geology program are partially or largely financed through Federal Receipts.

Alaska's communities at high risk from major geologic hazards are home to 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 development and implementation of building codes, land-use zoning, right-of-way siting, 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 should be concentrated. These maps are critical for emergency planning and the allocation of emergency-response resources prior to an adverse event.

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

A major continuing program headed by the Engineering Geology section but also involving members of the Mineral Resources section is the geologic mapping and hazards evaluation of the proposed natural gas pipeline corridor from Delta Junction to the Canadian border. The purpose of this multi-year project is to provide detailed geologic information of a 12-mile-corridor on which to base alignment decisions, engineering design, permitting, and planning for future development along the Alaska Highway. Following acquisition of high-resolution airborne geophysical data in 2006, DGGS began collecting field data from Delta Junction eastward. Field work is expected to be completed by 2010, with final reports and maps to be published in 2011.

A significant recent effort of the Engineering Geology section over the last four years has been in support of MapTEACH (Mapping Technology Experiences with Alaska's Cultural Heritage), an NSF-funded collaborative project with the University of Wisconsin Environmental Remote Sensing Center (ERSC) and the University of Alaska Fairbanks Land Resources/Global Change program. MapTEACH is a field-based geoscience outreach program for middle- and high-school students in rural Alaska that emphasizes hands-on experience with geoscience and spatial technology in conjunction with traditional activities. The project came to the end of its NSF funding in April 2008 and has now been adopted by the University of Alaska Geography program as its flagship K-12 outreach program. DGGS will continue to be involved in a limited capacity with MapTEACH activities to enhance community understanding of landscape processes and natural hazards in rural Alaska, and to foster appreciation of state-of-the-art technology tools and data sets that can be applied to informed community planning and decision making.

Major new projects starting this year have been developed in response to the overwhelming need for base-line geologic mapping and natural hazards evaluations in and near communities that are being affected by severe erosion and flooding problems, some of which are likely to be exacerbated by climate change. Thawing permafrost and possible sea level changes are also a growing concern for many Alaskan communities. DGGS recognizes the importance of reliable scientific information to help the State and its communities prepare for potential emergency situations resulting from geologic hazards, including those that are affected or amplified by climate change. DGGS will perform geologic studies to identify high risk areas where proactive mitigation efforts will be needed and useful, as well as evaluating proposed relocation sites for communities faced with the immediate need to move to a safer location.

OBJECTIVES

1. Help mitigate risks to 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 conjunction with minerals resources mapping projects.

FY2009 ENGINEERING GEOLOGY PROJECTS

Detailed project summaries for the following Engineering Geology projects appear in the section *Project Summaries—FY2009*:

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.
- As part of the Alaska Coastal Management Program, conduct reviews of district coastal management plans, Coastal Policy Questionnaires, and consistency applications to determine compliance with the program's natural hazards standards (11 AAC 112.210).
- When appropriate, conduct post-event hazard evaluations in response to unexpected major geologic events (e.g., earthquakes 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.

VOLCANOLOGY

The Volcanology program of DGGS works as part of an interagency consortium to mitigate hazards from Alaska volcanoes. The consortium is the Alaska Volcano Observatory (AVO), formed by Memorandum of Understanding in 1988. AVO cooperators are DGGS, the U.S. Geological Survey (USGS), and the University of Alaska Fairbanks Geophysical Institute (UAF/GI). In the past, the Volcanology program has existed as a sub-program in the Engineering Geology section; the Director established Volcanology as a separate section in early 2007.

AVO studies volcanoes to increase understanding of hazards at particular volcanoes and how volcanoes work in general; monitors volcanoes using seismology, geodesy, satellite remote sensing, field studies, and local observers; and provides timely and accurate warning of increasing unrest and eruptions to emergency management agencies, other government entities, the private sector, and the public. Most Alaska volcanoes are remote from human settlements, but all underlie the heavily traveled north Pacific passenger and cargo air routes between North America and Asia; thus the aviation sector is an important recipient of AVO monitoring and reporting.

The three component agencies of AVO (DGGS, USGS, UAF/GI) each bring particular strengths to the observatory, while sharing general expertise in volcanology (see figure). Among these agencies, DGGS has the primary AVO mandate for baseline geologic mapping and the state's mandate for hazards studies. DGGS's administrative flexibility has allowed us to build and maintain the AVO website, serving a large database of descriptive material about volcanoes, providing a cutting-edge system for intra-observatory communication and data sharing, and providing notices of eruptions and unrest to users in public, private, and government sectors. The database and information dissemination tools built around the database (see GeoDIVA project description, p. 48) has emerged as the most powerful such tool among volcano observatories worldwide. Particular strengths of the USGS are the federal hazards mandate and direct ties federal agencies. UAF/GI brings a research mandate and access to technological resources (such as satellite data downlink centers) beyond the financial capability of AVO.

Funds for DGGS participation in AVO come from cooperative agreements with the USGS. The majority of these funds in turn come from the USGS Volcano Hazards Program base budget. The remainder come to USGS as specially mandated congressional programs through other agencies in other departments, such as Transportation and Defense. The ongoing national concern about earmarking puts these congressionally-mandated additions at risk. The impact to AVO would be significant if these funds are reduced or become unavailable. The outcome of the federal budget process is unknown, and difficult to predict.

OBJECTIVES

1. Help mitigate risks to public safety and health by providing information on volcanic hazards as they affect human activity.
2. Represent the State of Alaska's interests within the multiagency Alaska Volcano Observatory.
3. Develop and maintain the Alaska Volcano Observatory website as a primary communications vehicle to deliver information about Alaska's volcanoes to the public and provide internal communications and data exchange among AVO personnel.
4. Provide comprehensive information on Alaska volcanoes, including past history and current activity, to the general public, agencies, and volcanologists worldwide.

FY2009 VOLCANOLOGY PROJECTS

Detailed project summaries for the following Volcanology projects appear in the section *Project Summaries—FY2009:*

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

- Assist AVO in volcano monitoring. AVO monitors volcanoes using short-period seismometers, broadband seismometers, continuous telemetered GPS, satellite imagery, gas measurements, web cameras, and local observer reports. AVO maintains seismic networks on 30 active volcanoes (up from four in the mid-1990s), and monitors more than 100 volcanoes twice daily by satellite. While not a primary DGGS activity, DGGS assists in volcano monitoring when needed during eruption events.
- Provide advanced GIS expertise to all component agencies in AVO. This includes producing base maps in areas where 1:63,360-scale topographic maps do not exist, retrieving and georegistering maps from discontinued map series, and producing a variety of other georegistered data products. DGGS also provides expertise in finalizing and troubleshooting GIS-based map publications using standard GIS techniques for numerous projects in all AVO component agencies.
- Provide helicopter and ship logistics. DGGS manages helicopter charter procurement for all major AVO projects, ship charters for projects that are far enough from population centers to require ship-based helicopters, and fixed-wing charter for volcanic gas measurement flights. Having all the contracting done by a single agency results in significant budgetary and logistic efficiencies.
- Perform geochemical data procurement and archiving, coordinating geochemical analyses, and maintaining the archive of those data. These data share rigid inter-project quality controls, making the combined data set a major resource for researchers and adding substantially to the value of the data from individual geologic mapping projects.
- Represent DGGS to CUSVO/NVEWS. DGGS is one of the charter members of the Consortium of U.S. Volcano Observatories (CUSVO), which provides coordination among the five volcano observatories in the United States. The National Volcano Early Warning System (NVEWS) is a major emerging initiative of CUSVO; the DGGS project leader serves on the NVEWS steering committee and chairs one of the five subpanels developing the program implementation plan.
- Provide information on geothermal resources to state and federal agencies, the private sector, and the public.

GEOLOGIC COMMUNICATIONS

The Geologic Communications Section staff edits, designs, publishes, and disseminates technical and summary reports and maps generated by the Division's technical projects about Alaska's geologic resources. The maps and reports released through this section are the state's primary avenue for widely disseminating detailed information and data relating to Alaska's subsurface mineral and energy wealth, its geologic construction materials, and its geologic hazards. These printed and/or digital format 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 provides information to the public on a wide range of topics including mineral and energy resources, prospecting, earthquakes, volcanoes, and permafrost. The front desk also assists customers in understanding geological and geophysical maps, and manages sales of geologic reports, maps, and digital data. Additionally, the section prepares displays and represents the division at geologic conferences and events. The section produces an annual report summarizing 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; 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, and helping teachers plan earth science units.

The division's Digital Geologic Database project was initiated by the federally funded Minerals Data & Information Rescue in Alaska (MDIRA) program and 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 website 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. The section established a website 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. These efforts developed into a major project to establish, maintain, and enhance a state–federal multi-agency Internet-accessible Alaska geologic database management system. Federal funding was secured to scan, convert to digital format, and post the entire DGGS collection of publications on our website. The U.S. Geological Survey provided additional funds to do the same for all Alaska-related USGS publications and make them available via the DGGS website.

The Geologic Communications Section is supported by the General Fund, Program Receipts, and Federal Receipts.

OBJECTIVES

1. Disseminate new, accurate, unbiased, Division-generated data on Alaska's geology, as well as selected data from other sources, 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.

FY2009 GEOLOGIC COMMUNICATIONS PROJECTS

Detailed project summaries for the following Geologic Communications projects appear in the section *Project Summaries—FY2009*:

* MDIRA-supported project (see p. 14)

GEOLOGIC MATERIALS CENTER

The Alaska Geologic Materials Center (GMC) in Eagle River 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 supported by the General Fund budget and in-kind contributions from industry. Additional financial support is received annually from the Alaska Oil & Gas Conservation Commission. The private sector contributes the cost of delivering all new samples, sample preparation and analyses, sample logs, and data logs, and occasionally donates storage containers and/or shelving.

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 two Division geologists and a student intern. 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 geologic materials from Alaska. A voluntary 14-member board advises the curator and DGGS on matters pertaining to the GMC.

With federal funding and in cooperation with the Department of Transportation & Public Facilities, DGGS recently completed a concept study for construction of a new materials center to replace the existing GMC. The sample collection long ago exceeded available warehouse space, with the overflow now occupying 60 unheated tractor-trailer type portable storage containers. Limited space and unsuitable site conditions preclude significant expansion at the existing site in Eagle River. DGGS is considering a proposed new site on state land south of Eagle River and is now looking for sources of funding to finance the project. The concept study report is available on the GMC web page at www.dggs.dnr.state.ak.us/GeologicMaterialsCenter.htm. In 2007, DGGS used information from this report to develop a brochure explaining the functions and services of the GMC and the need for an upgraded facility. The brochure is presented in the appendix of this report. DGGS has begun phase I of the design work for a new facility with support of state Capital Improvement Project (CIP) funds. This work is being conducted by a private engineering firm through a reimbursable services agreement with the Department of Transportation and Public Facilities.

OBJECTIVES

1. Encourage responsible resource development and in-state employment opportunities by increasing accessibility to representative geologic samples and information concerning oil, gas, and mineral exploration.
2. Advance the knowledge of the geology and resources in Alaska's 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–FY2008* (p. 68).

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; 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; and any other support necessary to further increased efficiency or savings in acquiring and disseminating knowledge of the geology of Alaska.

OBJECTIVE

1. Facilitate the efficient administration 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.
- Provide accurate, timely processing of employee timesheets, invoices, procurement records, and other documentation required by the State; ensure strict adherence to State archiving requirements.
- Minimize the cost of transportation to and from the field by coordinating personnel travel and supply shipments.
- Coordinate Division vehicle use to minimize requests for reimbursement for personal vehicle mileage.
- Make travel arrangements and complete travel authorizations to ensure use of the lowest-cost travel options.
- 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.

EMPLOYEE HIGHLIGHTS

~ ~ ~ WELCOME ~ ~ ~

TRENT HUBBARD began working for DGGS as a Geologist IV in April 2008. He grew up in upstate New York, but has lived in North Dakota and Missouri, as well as Juneau and Denali Park in Alaska. Trent earned his B.S. in Geology from St. Lawrence University, and his M.S. in Geology (Fluvial Geomorphology) and Ph.D. in Geology (Glacial Geomorphology) from University of North Dakota. Trent has established quite a resumé, working as an Assistant Director for the Foundation for Glacier and Environmental Research; as an Adjunct Instructor at University of Alaska Southeast as well as Northern Military Programs, University of Alaska; as a GIS Consultant for the Central Council of the Tlingit Haida Indian Association; as Assistant Professor of Earth Science at Central Missouri State University; and in various positions with Metallogeny, Inc.

When not in the office, Trent is often running, cross-country skiing, or reading. He ran his first (and not last) marathon in the fall of 2008. Along with having a great love for animals, Trent is also an avid hockey fan. Some of his favorite places to visit include the Columbia icefields region in the Canadian Rockies; Moab in Utah; and driving the northern side of the great lakes.

JOE ANDREW began working with the DGGS Mineral Resources section in June of 2008 and spent a rainy summer doing fieldwork (63 of 68 days with rain or snow). Before joining DGGS he was an assistant professor of geology at Youngstown State in Ohio. He began his geology career with a B.S. from Penn State and then completed a Masters degree at the University of New Mexico studying the evolution of a Quaternary basalt field. Most of the next decade was spent doing structural geology and mapping field work in the Death Valley area of California. He worked as a gold exploration geologist for the C.R. Briggs Corp. in 1996 and 1997 mapping gold-mineralized normal faults at inch-to-mile scale. At the University of Kansas he completed a PhD dissertation project on the structural history of the Panamint Range (the western side of Death Valley). This research included summer field seasons with temperatures in excess of 130ºF and not a cloud in sight. Joe's field truck did not have air conditioning and tended to overheat going over steep mountain passes so he had to run the heater to keep it from overheating. During one of the hottest days the temperature at midnight was 114 ºF. Joe's post-doctoral and subsequent research continued the study of tectonic activity of the Death Valley region, concentrating on Miocene to active deformation in this area.

Joe recently completed a research project examining the structural history of part of the Sierra Madre Occidental in northwestern Mexico. This area changes from being a hot desert to tropical jungle with the monsoon rains. The first half of the field season was dry, hot, cloudless and the vegetation was gray and dead. After the rain everything was bright green and there were lots of strange plants, insects and animals and it rained every day. The first day of rain brought on a once in a lifetime experience of front row seat to a mudflow as the main steep valley went from bone dry to having water several meters deep—it sounded and felt like a freight train going by. He spent his time in Mexico cursing the cholla cactus, pulling out cholla spines from his body with pliers and learning inappropriate Spanish vocabulary.

When not working Joe can be found in possession of various hot sauces. He enjoys his cabin without plumbing near Fairbanks and likes to walk, ski or ride his bike in the snow.

~ ~ ~ GOODBYE ~ ~ ~

DIANA SOLIE has retired after 19 years of service to the State of Alaska. Diana received her B.A. in Music, with a minor in geology, from Allegheny College in Meadville, Pennsylvania. She continued her education, earning her B.S. degree in Geological Sciences from the University of Alaska Fairbanks. During part of her time with DGGS (1981–1989) she took the winters off to attend Virginia Polytechnic Institute and State University in Blacksburg, Virginia, earning her Ph.D. in Geological Sciences. In addition to working for DGGS as a geologist, she has worked as the Regional Engineering Geologist and the Acting Materials Engineer for the Alaska Department of Transportation and Public Facilities; Director of the UAF Geology Field Camp, Affliate Professor, and was involved with the Upward Bound Math/Science program for the Department of Geology & Geophysics, University of Alaska Fairbanks; and as an Adjunct Assistant Professor at the American University in Bulgaria.

While in Bulgaria, Diana served as director and helped conceptualize and initiate an English-speaking elementary school for expatriate and Bulgarian children. Diana puts her musical talent as a cellist to work when performing with the Arctic Chamber Orchestra and the Fairbanks Symphony Orchestra, most recently playing as assistant principal cellist. She has had the opportunity to tour throughout Alaska with the Arctic Chamber Orchestra.

Diana has been an Alaska resident since 1976. She and her husband have a 19-year-old son.

~ ~ ~ MORE THAN 25 YEARS OF SERVICE ~ ~ ~

LAUREL BURNS received her B.S. from the Geology Department at the University of Alaska in 1978. She earned her M.S. from the Applied Earth Science Department and her Ph.D. from the Geophysics Department at Stanford University in 1981 and 1983. Laurel concentrated on mafic and ultramafic rocks in the northern Chugach Mountains of south-central Alaska, utilizing gravity and aeromagnetic modeling, geologic mapping, and detailed igneous petrology while at Stanford. She worked for the Geophysics Branch of the U.S. Geological Survey performing aeromagnetic and gravity modeling and computer programming, and was concurrently a Research Assistant in the Geophysics Department.

Laurel began working for the Alaska Division of Geological & Geophysical Surveys as a Geological Assistant for summer field projects in the summer of 1979, and continued each summer until she began full time as a geologist in June 1983. Laurel spent 10 years at DGGS carrying out geologic field mapping in various places in Alaska, probabilistic mineral resource modeling, and geochemical statistical studies. She was an invited participated in a U.S.–U.S.S.R. cooperative project on mafic and ultramafic rocks in the Soviet Far East in 1990 and 1991.

Since 1993, she has managed the then new Alaska Airborne Geophysical and Geological Mineral Inventory Program, designed to acquire geophysical data and geological mapping on 40 million acres of state interest lands with perceived mineral potential. Laurel was chief of the Minerals Section for 7 years and currently is a Geoscientist I whose specialty is airborne geophysical data.

Laurel enjoys being in boats of all types (particularly on fast rivers), traveling, playing games, dancing, reading, Russian language, and she dreams of uncluttered spaces.

Deputy Director **Rod Combellick** joined the Division of Geological & Geophysical Surveys as a graduate student intern in 1981, then as a Geologist III in 1982. He became chief of the Engineering Geology section in 1987, Deputy Director in 2002, and served as Acting Director in 2003–2004. He holds a Bachelor of Science degree in geology from the University of Washington and a Master of Science degree in geology from the University of Southern California. His own project work with DGGS has focused on surficial geology, engineering geology, and earthquake hazards. He has been involved with the Alaska Coastal Management Program throughout most of his state career, has served on the state Seismic Hazards Safety Commission since its inception in 2005, and is the Alaska geoscience delegate to the Western States Seismic Policy Council.

Rod has been an Alaska resident since 1977, spending the first four years in Juneau after moving to the state from his home state of Colorado. Outside the office, he enjoys flying, music (he plays classical and church organ), photography, fishing, bicycling, and skiing. He has two children ages 27 and 23.

Jim Clough earned his B.A. in Geology from the College of Wooster in Ohio in 1975 and decided to forego modern carbonate studies in Florida and instead head to Alaska that fall to earn an M.S. degree in Geology (1981) at the University of Alaska Fairbanks. Jim first worked for DGGS as a geology intern in 1978 and in 1980 was assistant crew leader for the U.S. Bureau of Mines' eastern Prince William Sound mineral assessment team. Early in Jim's career, he learned the value of studies of modern depositional environments to better understand ancient rocks and undertook opportunities for carbonate research on Andros Island, Bahamas (1976), Makatea Atoll (1985) and the Great Barrier Reef (1985–1986). His main expertise centers around carbonate facies analysis, microfossils, and karst systems. Jim began his professional career at DGGS in January 1981 with carbonate studies, field mapping, and energy resource assessments for the state. Jim was chief of the Energy Resources Section for more than 10 years and now is a Geological Scientist I specializing in carbonate research related to ongoing energy resource projects. Jim writes: "I have enjoyed these past 27 plus years serving the people of Alaska and have been fortunate to combine my passion for geology with tropical ocean dives and skiing across the frozen tundra. My other interests involve learning about different cultures and languages that include Yup'ik and Russian."

John Reeder was born and raised in Palmer, Alaska. He is one of few Alaskans who can say he attended the same school his mother did.

After graduating high school in 1968, he continued his education at the University of Idaho, earning a B.S. in Geological Engineering. John went on to earn an M.S. in Geology (1974), an M.S. in Geophysics (1983), and a Ph.D. in Geology (1981) at Stanford University. His fields of specialty are general and regional geology, regional tectonics, neotectonics, surficial geomorphic processes especially in tectonically active areas, recent geochronology of surficial earth processes, volcanology, physical crustal processes and process modeling, seismology, and natural hazards.

John started working for DGGS in 1979. In 1987 he moved from the Anchorage office to become the curator of the Geologic Materials Center located in Eagle River. John has been instrumental in receiving and archiving many thousands of samples, mostly from oil & gas and mineral-exploration companies, for the benefit of future exploration projects and resource management.

John and his wife Rina own a historial home in Venice, Italy, where they are both residents.

PROJECT SUMMARIES—FY2009

Alaska faces the challenge of growing a healthy economy from its 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 earth-science information 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 37 projects that DGGS is pursuing in FY2008 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 arrange-ments so that the Division's work provides the greatest possible benefit from the public's investment.

Energy Resources

Mineral Resources

**MDIRA-supported project (see p. 14)*

Engineering Geology

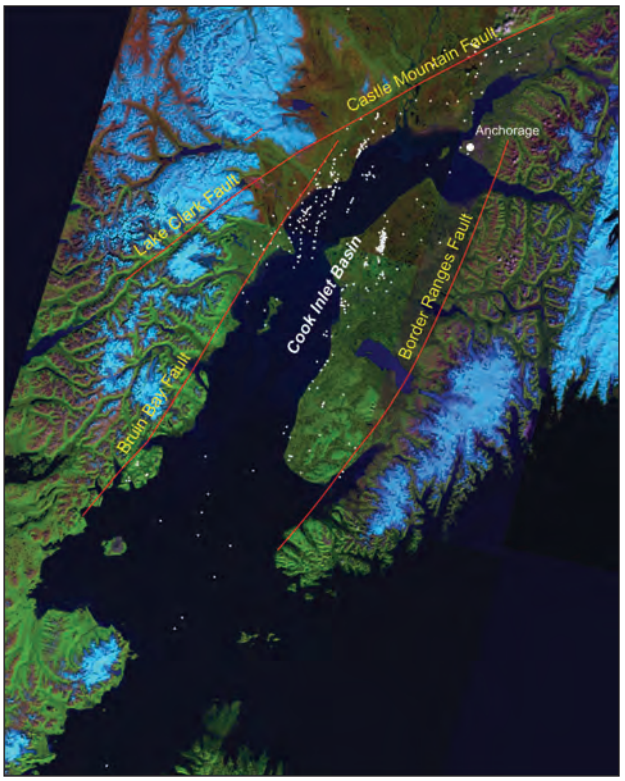
Volcanology

Geologic Communications

Geologic Materials Center

COOK INLET GEOLOGY AND HYDROCARBON POTENTIAL PROGRAM

Increasing demand and predicted deliverability shortfalls for Cook Inlet gas to south-central Alaska customers pose a serious threat to the region's economy. These factors make it an ideal time to promote new exploration investment in the Cook Inlet region. The Alaska Division of Geological & Geophysical Surveys (DGGS) is responding to this challenge by leading a multi-year, multi-agency program of relevant applied geologic research designed to provide high quality data to the geologic community and public policy makers. This program is a collaborative effort between DGGS, the Alaska Division of Oil and Gas (DOG), and the University of Alaska Fairbanks.



Historically, Cook Inlet exploration has centered around the search for large faulted fold structures with four-way closure. Now that nearly all large structures have been found and tested, the exploration focus is gradually shifting to subtle stratigraphic traps. Successful exploration for these traps requires detailed knowledge of potential reservoir geometries, geologic factors controlling these geometries, and geologic controls on reservoir producibility. The initial goal of the DGGS Cook Inlet program is to improve understanding of potential reservoir geometries and their geologic controls.

During 2008 DGGS and DOG continued documenting the geometry of potential reservoir sand bodies in Tertiary age nonmarine sandstones between Soldotna and Homer, and in the Capps Glacier–Beluga River region west of Anchorage. Work on coastal bluff exposures near Homer and Anchor Point is allowing our team to develop a better understanding of the geometry of late Miocene age river channel deposits (see photo) that form gas reservoirs in several producing Cook Inlet fields. This work is also quantifying porosity and permeability structure of these sands, which exerts significant control on their function as reservoirs. Work in the Capps Glacier–Beluga River region is documenting alluvial fan and associated gravelly river deposits along the western basin margin. These rocks record deposition during a period characterized by basin-margin faulting and significant volcanic activity. This work is improving our understanding of sand body geometries and reservoir quality of rocks that serve as producing reservoirs in nearby fields such as Granite Point. An important component of this program is an effort to map the base of Tertiary succession throughout upper Cook Inlet and to map the subcrop pattern of underlying Mesozoic strata. The latter rocks include critically important oil-prone rocks that are the source of all of upper Cook Inlet's oil.

This project is funded by the State of Alaska and a small industry consortium consisting of Benchmark Oil and Gas, Chevron North America, and Pioneer Natural Resources. These findings will be documented in a series of publications that will be available from the DGGS website (http://www.dggs.dnr.state.ak.us/). The first publications in this series will be available during winter–spring 2009.

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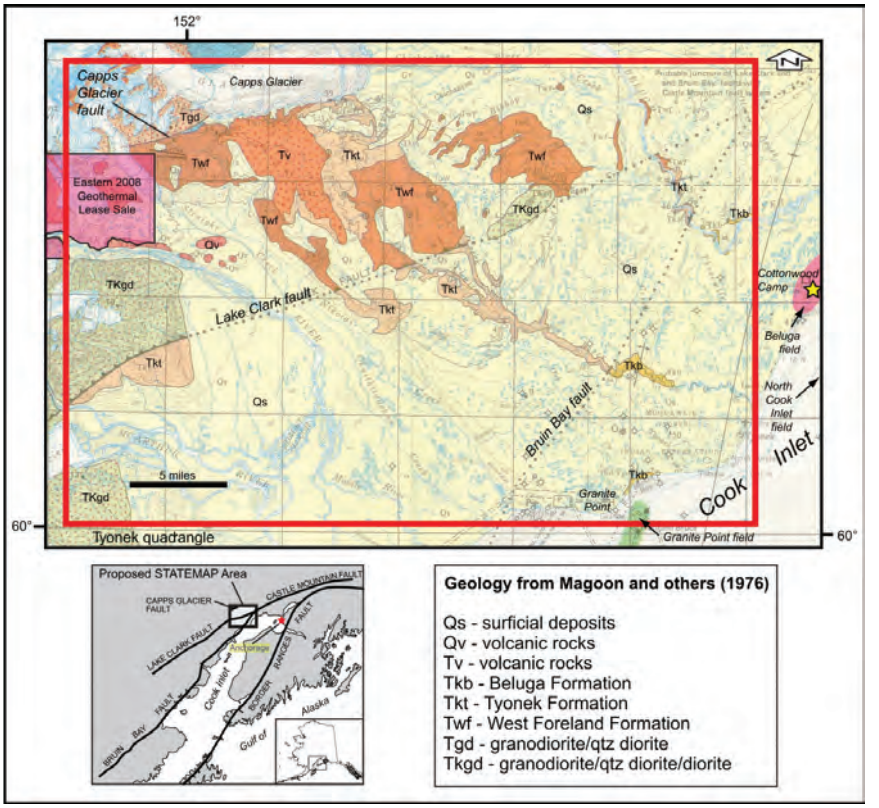
GEOLOGIC MAPPING IN THE TYONEK–CAPPS GLACIER AREA

Gas production from Cook Inlet basin has contributed significantly to Alaska's economy by providing inexpensive natural gas for industrial use, electric power generation, home heating fuel, and creating jobs for south-central Alaska. Rising demand, predicted deliverability shortfalls, and rising commodity prices provide circumstances conducive to promoting new exploration investment in the Cook Inlet region.



All oil and gas production in Cook Inlet basin comes from structural traps involving Tertiary age nonmarine rocks. No exploration in the basin has focused exclusively on the search for stratigraphic traps. Stratigraphic traps are subtle; successful exploration in this geologic environment requires very detailed information on sand body geometries and factors controlling these geometries. Exposures of Tertiary age rocks are limited to only a few areas around the basin margin and are critically important to understanding stratigraphic trap potential. The Tyonek Quadrangle includes some of the best exposures of Tertiary formations that serve as reservoirs in producing fields along the west side of the basin and represent invaluable outcrop analogs for understanding the potential for stratigraphic traps in the subsurface. The planned project will provide important data for developing a better understanding of this exploration concept in Cook Inlet basin, which will help promote new exploration in the region and provide improved information for resource management.

The project is aimed at new 1:63,360-scale bedrock geologic mapping in the Tyonek Quadrangle during the 2009–10 field seasons. This area straddles the northwest margin of Cook Inlet basin, includes extensive exposures of Tertiary age nonmarine rocks, and encompasses nearly 800 square miles of State and Native corporation land. Available geologic mapping in this area either predates modern stratigraphic nomenclature used in the basin or lacks structural details necessary for reconstructing the geologic history important for understanding controls on sand body geometries and reservoir quality. Concurrent with bedrock mapping, the reservoir quality of Tertiary stratigraphic units in the map area will be studied and seismic hazards that represent potential threats to nearby population centers and petroleum production infrastructure will be investigated.

Pending receipt of partial federal funding through the U.S. Geological Survey's STATEMAP program, a preliminary map of the northern half of the project area will be submitted to that organization in late Spring 2010, and a preliminary map of the entire project area will be submitted in later Spring 2011.

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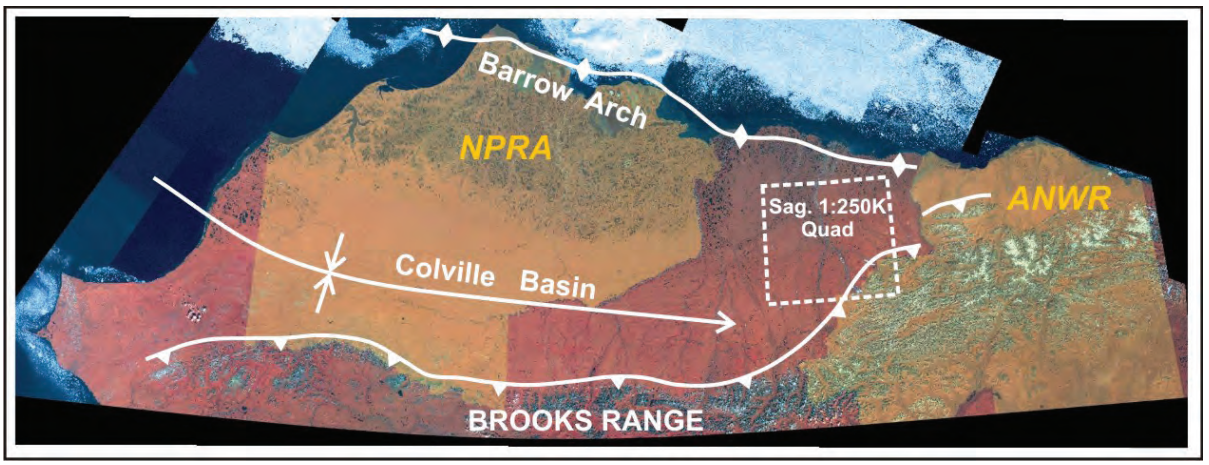
BROOKS RANGE FOOTHILLS & NORTH SLOPE PROGRAM

Alaska's North Slope remains one of the most promising onshore oil and gas provinces in all of North America. The Division of Geological & Geophysical Surveys (DGGS) continues its leadership role in furthering the geologic understanding of this petroleum system, primarily through investigations of rocks exposed in the foothills of the northern Brooks Range. This program was developed in response to the need for high quality, publicly available geologic data to stimulate exploration for hydrocarbons in northern Alaska. The cost of this program is shared by major and independent oil and gas companies. While directed by DGGS, this research effort is a multi-agency collaboration that includes the Alaska Division of Oil & Gas (DOG), the United States Geological Survey (USGS), the University of Alaska, and others.



During the 2008 field season, the program continued to focus on detailed geologic mapping (see p. 34) as well as stratigraphic studies of key reservoir and source rock intervals in the east-central North Slope. The collection of detailed sedimentologic data is providing new constraints on the depositional history and correlation of units, leading to an improved understanding of how this hydrocarbon-rich basin evolved. In particular, recent work on Upper Cretaceous rocks exposed in the south-central Sagavanirktok Quadrangle (see map) has provided valuable insight into the time-transgressive northeastward progradation of genetically related shelf, slope, and deep water facies. In collaboration with DOG, we are integrating detailed outcrop observations with available well and 2-D seismic data, greatly increasing the robustness of our stratigraphic correlations and regional geologic models. In addition to stratigraphic studies, the program also continued to evaluate the structural geology of the inner Brooks Range foothills, documenting the geometry and style of deformation that influenced hydrocarbon maturation and migration.

Notable recent DGGS publications from this program include a series of seven reports on Cretaceous stratigraphy. Another collection of papers is in progress and will summarize additional structural and stratigraphic studies relevant to evolution of the North Slope petroleum system (anticipated release in March, 2009).

Exposures of Paleocene nonmarine strata along the Sagavanirktok River. Similar strata along these bluffs are strongly oil-stained. Note pump station #2 in the background.

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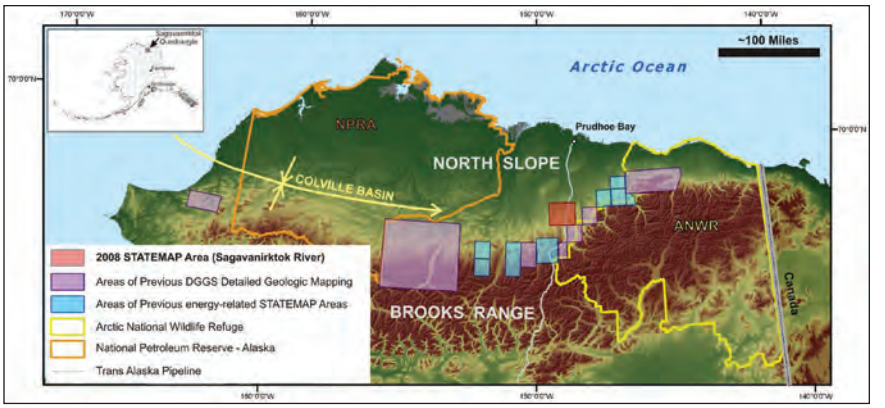
GEOLOGIC MAPPING IN THE SAGAVANIRKTOK RIVER AREA

Many regions of the North Slope that are prospective for oil and gas exploration are covered by tundra, thus limiting the collection of geologic data to very costly subsurface methods such as seismic reflection and drilling efforts. However, geologic investigation of related rocks exposed at the surface in the northern foothills of the Brooks Range provide a unique opportunity to study structural and stratigraphic relationships, often providing predictive insights into the subsurface petroleum geology elsewhere on the North Slope. The Energy Resources Section at DGGS conducts bedrock geologic mapping as an integral component of the Brooks Range Foothills and North Slope Program (see also p. 33). Our long-range objective is to eventually produce a contiguous series of detailed geologic maps along the entire foothills belt, thereby establishing a regional geologic framework necessary to understand the evolution of the petroleum system in support of resource management and industry exploration on State lands. In addition, our ongoing work provides critical baseline geologic information that helps constrain the resource potential and long-term supply to the proposed natural gas pipeline.



During summer 2008, DGGS, in collaboration with the Alaska Division of Oil and Gas, mapped approximately 600 square miles of the south-central Sagavanirktok Quadrangle at 1:63,360 scale (see map). A significant portion of this area is mantled by younger Quaternary deposits (see p. 50), however the bedrock geology can be pieced together from a series of linear resistant ribs (see photo) that trace out several large folds. The new mapping has improved our understanding of fold geometry, including the recognition of progressive changes in the trend of fold axes, perhaps related to the age of contractional deformation. Furthermore, we were able to document significant variability in the plunge of some large anticlinal structures—a key component in evaluating hydrocarbon trapping mechanisms.

Detailed stratigraphic observations also enhanced our knowledge of how Campanian age (upper Cretaceous) rocks correlate with one another, allowing for a more robust sequence stratigraphic interpretation that integrates the geology of the central and eastern North Slope. To supplement the geologic mapping, we collected an extensive suite of samples to better resolve the age of these potential reservoir rocks. In particular we sampled a large number of thin air-fall volcanic deposits (tuff and bentonite) to date using high resolution U-Pb zircon geochronology (see photo). During the course of mapping we also documented three oil-stained localities as well as numerous more mildly petroliferous sandstones.

This work was supported in part by the federally funded STATEMAP program; the final map product will be released as a DGGS Report of Investigation late in 2009.

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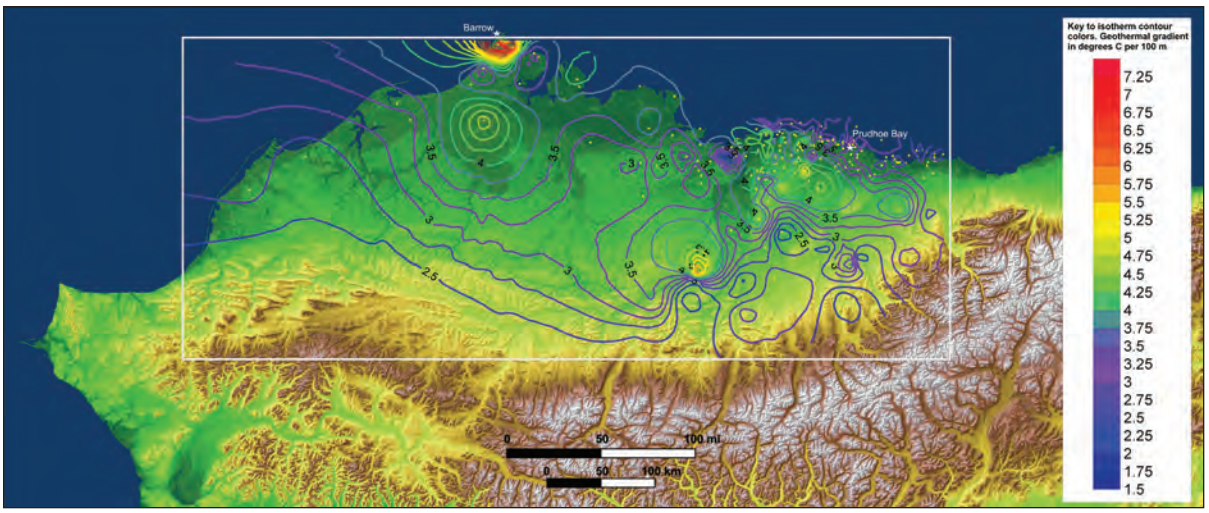
GAS HYDRATES: EVALUATION OF ALASKA NORTH SLOPE GEOTHERMAL GRADIENTS

Gas hydrate is a crystalline solid consisting of gas molecules, usually methane, each surrounded by a cage of water molecules that are stable at low temperatures and/or high pressures. One volume of gas hydrate is typically equivalent to 160 volumes methane gas. The estimated equivalent volume of gas trapped within permafrost-associated gas hydrate accumulations in northern Alaska is about 590 trillion cubic feet (TCF). Production models of gas hydrate prospects indicate that significant volumes of gas associated with the gas hydrates in northern Alaska could be technically recoverable. The 2008 U.S. Geological Survey gas hydrate assessment estimates that about 85 TCF of onshore gas hydrates beneath the Alaska North Slope may be technically recoverable.



Map showing isotherm contours of geothermal gradient based on corrected BHT data from North Slope exploration wells.

Small increases in the geothermal heat flow can adversely affect the presence and thickness of gas hydrate zones. DGGS initiated a program to evaluate corrected Bottom Hole Temperature (BHT) survey data derived from existing oil and gas wells to delineate areas of elevated geothermal gradient that adversely affect gas hydrate resources. A large dataset of drill-hole-temperature survey information of more than 6,000 wells drilled in sedimentary basins throughout Alaska makes possible the evaluation of variations in geothermal heat flow. The accuracy of BHT data is often affected by the time constraints imposed by the commercial nature of oil and gas wells. Because many wells are logged during or soon after the circulation of drilling fluids, during production flow of gas and fluids, and at high logging speeds, BHT may not precisely represent actual temperature. Therefore, BHT data collected from oil and gas wells after drilling commonly must be evaluated for accuracy and corrected to equilibrium conditions. Additionally, it is important to further correct these data for a number of geological factors including climate, topography, uplift, and erosion to attain maximum accuracy.

This project was funded by a grant from the U.S. Bureau of Land Management–Alaska, which supported a joint effort between DGGS and the Petroleum Engineering Department, University of Alaska Fairbanks. We compiled and corrected existing BHT data for 253 publicly-available oil and gas exploration wells from the North Slope to determine geothermal gradients for the region shown inside the gray box. The greatest density of available BHT well data is in the Prudhoe Bay–Kuparuk field area, followed by the region south of Barrow. Areas of increased heat flow are shown in warmer colors, yellow to red contours (isotherms of >5° to 7.4°C/100 m). Areas of cooler heat flow are shown in the green to dark blue isotherm contours (isotherms of <5° to 1.5°C/100 m). Regions of increased heat flow affect the stability field of subsurface gas hydrates. A preliminary report on this work was completed as graduate research at the University of Alaska in 2008. The final products, to be published as a DGGS Report of Investigation, will be a database of corrected bottom hole temperatures for selected North Slope exploration wells, and a regional map showing the modeled data and contoured isotherms of thermal gradient (where the data density allows). Products are scheduled for completion in June 2009.

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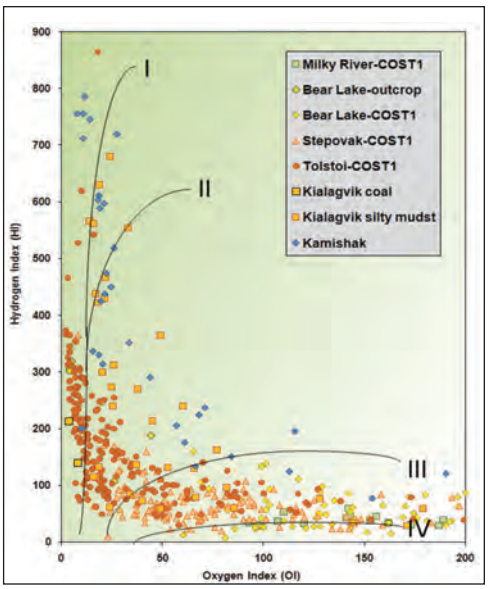
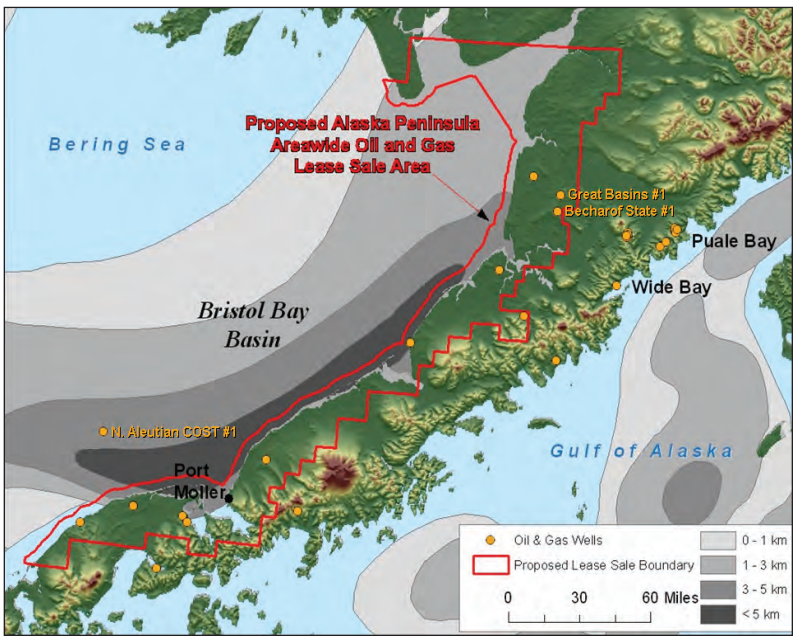
HYDROCARBON POTENTIAL OF THE BRISTOL BAY–ALASKA PENINSULA REGION

The Alaska Peninsula has not yielded commercial discoveries of hydrocarbons, although its petroleum potential is indicated by active oil seeps and numerous reported oil and gas shows in exploration wells. Despite a long history of exploration, including nearly 35 wells drilled onshore, there was relatively little publicly available geologic data to constrain this petroleum system. DGGS, working collaboratively with the Alaska Division of Oil and Gas (DOG), led a multi-year project starting in 2004 to collect baseline data bearing on the petroleum potential of this region. Field work for this program was completed in 2007 and a final report, completed in 2008, is available at www.dggs.dnr.state.ak.us/publications, with additional data at available at www.dog.dnr.state.ak.us/oil.

Data gathered during the course of this project has documented the following key observations: (1) the 9,000-foot-thick Miocene-age Bear Lake Formation includes sandstones with porosity and permeability values that suggest significant reservoir potential, (2) the presence of fine-grained rocks capable of forming reservoir seals and supporting hydrocarbon column heights ranging from 250 to 2,500 feet, (3) the presence of potential structural and stratigraphic traps, (4) the presence of favorable source rocks, including organic-rich, oil-prone zones within the Kamishak and Kialagvik formations, coal and carbonaceous shale in Tertiary and Mesozoic age rocks (see graph) , and active oil and gas seeps, and (5) significant parts of the basin are at optimum thermal maturity for the generation of liquid hydrocarbons (vitrinite reflectance values from 0.5 to 0.8).



This project has successfully expanded the database of relevant information on the petroleum potential of the Bristol Bay–Alaska Peninsula region. The timely release of our data contributed to renewed exploration interest, including participation in areawide lease sales. Samples collected for this project will be archived for future use at the DGGS Geologic Materials Center in Eagle River. This work was funded by the U.S. Department of Energy, Bristol Bay Native Corporation, and the State of Alaska.



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ALASKA COAL DATABASE – NATIONAL COAL RESOURCE DATABASE 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 occurrences in Alaska and archive the information in a single, readily accessible database available at the USGS website, http://energy.er.usgs.gov/products/databases/USCoal/. The NCRDS program is funded by USGS through a multi-year proposal process with final reporting at the end of each funding period.

Alaska's coal resources make up about half of the United States' coal-resource base and approximately one-sixth of the total world-resource base. Total identified Alaska coal resources (all ranks) amount to only about 160 billion short tons, yet hypothetical and speculative resources are as high as 5.5 trillion short tons. During the course of gathering information to expand the NCRDS database for Alaska, we recognized the need to collect new coal samples and current stratigraphic data for previously described occurrences. Sometimes a coal occurrence described in older literature is poorly located and the description is either inaccurate or inadequate for a proper resource assessment. The most frequent problems we have encountered are unverified coal seams and coal sample locations, suspect coal quality analyses, and insufficient stratigraphic control. The current NCRDS project was initiated in Interior Alaska to collect new coal quality data as part of the DGGS 1:50,000-scale bedrock- and comprehensive-geologic mapping project in the eastern Bonnifield mining district (described separately). Within this approximately 200-square-mile project area are exposures of Tertiary-age coals that are part of the Nenana coal basin. Coals of the Nenana Basin are mainly Miocene in age and occur in the Usibelli Group, which contains the coal-bearing Healy Creek, Suntrana, and Lignite Creek Formations and the associated Sanctuary and Grubstake Formations (listed from uppermost to lowermost). The Nenana Basin is one of Alaska's important coal provinces and has been subdivided into a number of genetically related coal fields. These include the Western Nenana, Healy Creek, Hosanna Creek, Rex Creek, Tatlanika Creek, Mystic Creek, Wood River, Delta, and Jarvis Creek fields. The eastern Bonnifield mining district map area includes the western Delta coal field where coal exposures appear to be mostly within the Healy Creek Formation, consisting of sandstone, conglomerate, siltstone, mudstone, shale, and coal. The Healy Creek Formation is interpreted to have originated from braided to high-sinuosity stream deposits with coal beds and shales accumulating in raised mires or abandoned mires built atop abandoned fluvial channels and flood-plain deposits. These coals likely have an apparent rank of subbituminous C.

Exposure of Healy Creek Formation on Red Mountain Creek. Coal seams are interbedded with fluvial siltstone to sandstone.

During 2008, we evaluated and sampled coals from a number of localities in the eastern Bonnifield map area. Selected coal samples will be analyzed for proximate, ultimate, and trace elements. The coal quality data will be incorporated into the final report of the east Bonnifield geologic map project by the end of 2009. Sample localities, coal seam characteristics, coal quality, and point-source data will be placed into the Alaska coal resource portion of the NCRDS.

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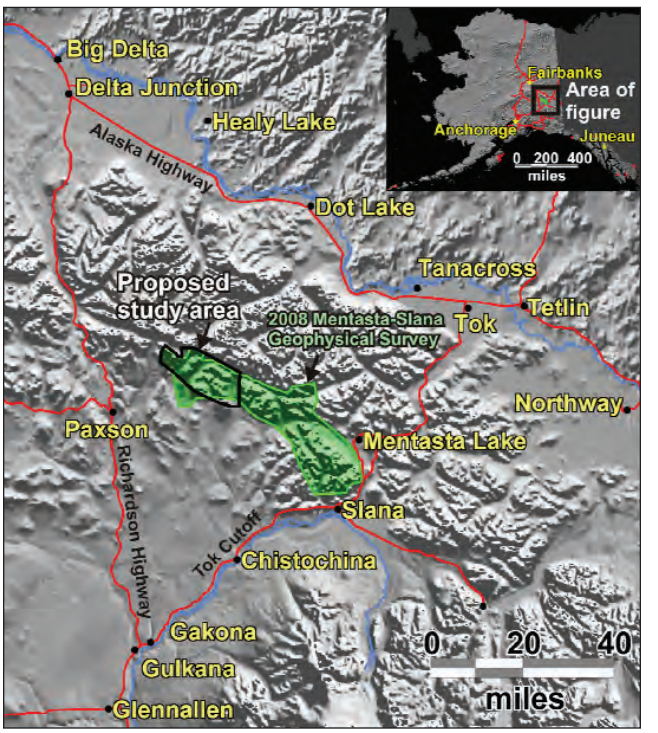
AIRBORNE GEOPHYSICAL/GEOLOGICAL MINERAL INVENTORY PROGRAM: AIRBORNE GEOPHYSICAL SURVEY AND GEOLOGIC MAPPING OF PARTS OF THE MT. HAYES, GULKANA, AND NABESNA QUADRANGLES, ALASKA

The Airborne Geophysical/Geological Mineral Inventory (AGGMI) program is a special multi-year investment to expand the knowledge base of Alaska's mineral resources and catalyze private-sector mineral development. The program 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 program 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 this program generally include (1) 1:63,360-scale aeromagnetic and airborne-electromagnetic maps; (2) 1:63,360-scale bedrock geologic maps; (3) and various other geological, geochemical, and geophysical data compilations. As a result of the AGGMI program, millions of dollars of venture capital have been spent in the local economies of the surveyed mining districts and adjacent areas in direct response to the new geologic knowledge provided by the surveys.

In FY09, the Alaska Division of Geological & Geophysical Surveys (DGGS) acquired airborne-geophysical data for parts of the Mt. Hayes, Gulkana, and Nabesna quadrangles as part of the AGGMI program. The 440-square-mile survey area, located between the Richardson Highway on the west and the Tok Cutoff on the east, is about 17 miles east of Paxson and 40 miles southwest of Tok. The area, a mixture of State, Federal, and Native lands, is in the Chistochina mining district. The northern edge of the survey generally follows the Denali fault zone. About 182,000 troy ounces of placer gold have been produced from the Chistochina mining district. Potential lode deposit types include copper–nickel–platinum-group-element occurrences associated with mafic-ultramafic rocks, porphyry(?) copper-gold; mesothermal, epithermal, and plutonic gold; skarns; replacements; and volcanogenic massive sulfide deposits. Reconnaissance geologic mapping suggests the area is composed largely of Paleozoic metavolcanic rocks and limestone, Triassic basalt and limestone, and plutons of various compositions and ages. DGGS's airborne geophysical surveys and follow-up detailed geologic mapping will provide a way to differentiate various lithologic units, especially distinguishing between plutonic rocks and the various metamorphic units, and to delineate older inactive faults, and recently active structures associated with the Denali fault system. By completing an integrated geophysical-geological mineral inventory study, new zones of mineralization may be identified, and extrapolation of some of the information into the surrounding areas may be appropriate.

Geophysical maps and digital data will be released as DGGS Geophysical Reports in early winter 2009. The second publication, containing a project report, interpretation, and electromagnetic anomalies, will be released in summer 2009. Field geologic mapping of the northwestern portion of the survey is scheduled to start in summer 2009, with maps to be published and made available on the DGGS website in 2010. DGGS believes that these data will lead to a better understanding of the geologic framework of the area, and will stimulate increased mineral exploration investment within the survey area and the surrounding area.



Map showing the locations of the airborne-geophysical survey area (green polygon) and mapping area (black outline) in relation to rural communities and transportation corridors. Base map is a digital elevation model with a grid-cell size of 300 m.

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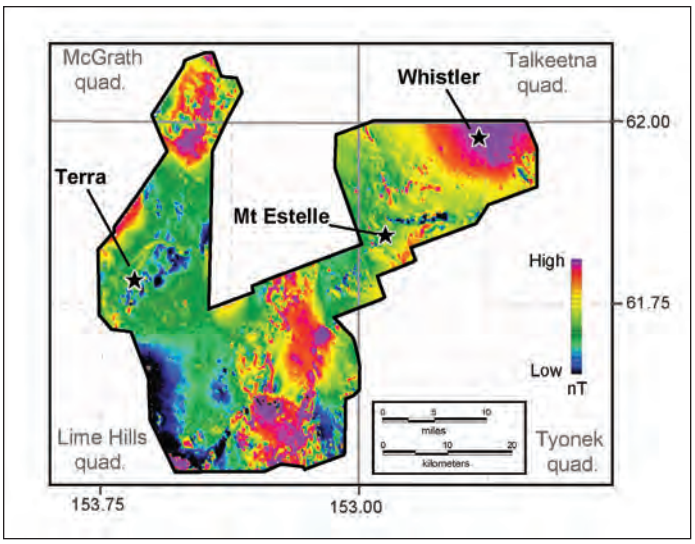
AIRBORNE GEOPHYSICAL/GEOLOGICAL MINERAL INVENTORY PROGRAM: AIRBORNE GEOPHYSICAL SURVEY OF THE STYX RIVER AREA, LIME HILLS, TYONEK, AND MCGRATH QUADRANGLES, SOUTH-CENTRAL ALASKA

The Airborne Geophysical/Geological Mineral Inventory (AGGMI) program is a special multi-year investment to expand the knowledge base of Alaska's mineral resources and catalyze private-sector mineral development. The program 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 program 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 this program generally include (1) 1:63,360-scale aeromagnetic and airborne-electromagnetic maps; (2) 1:63,360-scale bedrock geologic maps; and (3) and various other geological, geochemical, and geophysical data compilations. As a result of the AGGMI program, millions of dollars of venture capital have been spent in the local economies of the surveyed mining districts and adjacent areas in direct response to the new geologic knowledge provided by the surveys.

In FY08, the Alaska Division of Geological & Geophysical Surveys (DGGS) acquired airborne-geophysical data for the Styx River area in south-central Alaska as part of the AGGMI program. The survey area, all state-owned land, is located about 120 miles northwest of Anchorage. The survey covers about 715 square miles of prospective mineral terranes in the McGrath and Yentna mining districts. A contribution to the program by the mineral industry allowed us to add about 190 square miles to our survey area. Most of the abundant prospects and occurrences throughout the area are considered polymetallic veins, copper-gold porphyries, or mixtures between those deposit types. Lead-zinc skarns, molybdenum-bearing quartz veins, and other deposits types are also thought to be present. The areas around the Terra, Whistler, and Mount Estelle prospects are currently being actively explored as well as several other areas.



Geophysical data and maps were released in January and June 2008. Data and maps are available for free down-load from the DGGS Web site (www.dggs.dnr.ak.state.us). A presentation on the geophysical data was given at the Alaska Miner's Association Annual Convention in November 2008 in Anchorage, Alaska. A modified version of this presentation will be available on the DGGS Web site in the future. An additional Styx River geophysical publication, containing a project report, interpretation, electromagnetic anomalies, and stacked profiles, will be released in FY09.

Detailed geologic mapping is not available for the Styx River area. Airborne geophysical surveys and future detailed geologic mapping will provide a way to differentiate various lithologic units, especially distinguishing between granitic rocks and the various metamorphic units, and to delineate regional structures. By completing an integrated geophysical-geological mineral inventory study, new zones of mineralization may be identified, and extrapolation of some of the information into surrounding areas may be appropriate. DGGS believes that geophysical data, which leads to a better understanding of the geologic framework hosting identified and potential ore deposits in these districts, will stimulate increased mineral exploration investment within these belts of rocks and the surrounding areas, and will provide information useful for state resource management and land-use planning.

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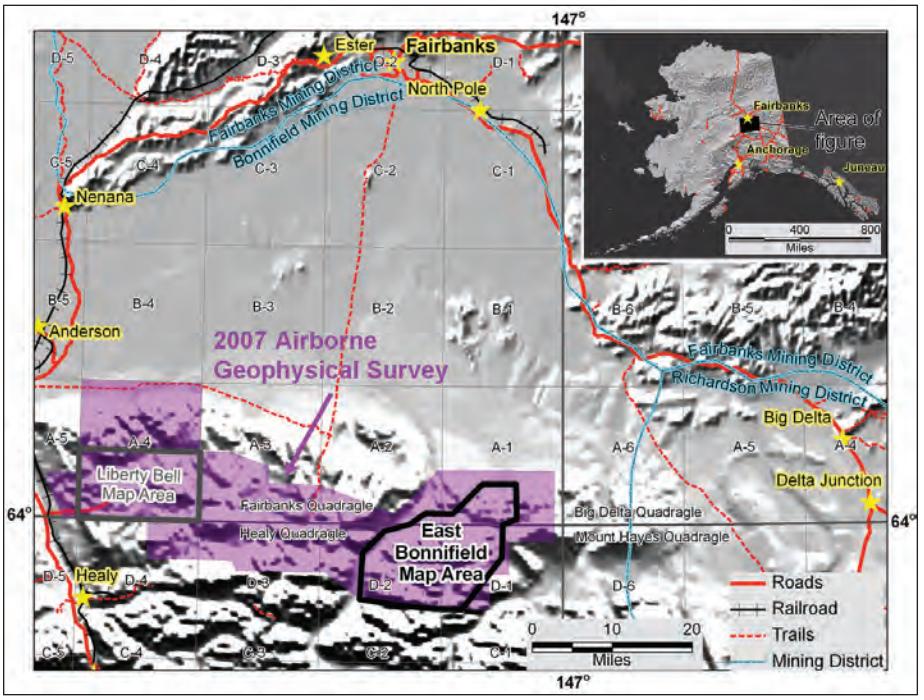
AIRBORNE GEOPHYSICAL/GEOLOGICAL MINERAL INVENTORY PROGRAM: GEOLOGIC MAPPING IN THE EASTERN BONNIFIELD GEOPHYSICAL SURVEY TRACT

Historic and active placer mines in the Bonnifield mining district have produced more than 86,000 ounces of gold; the region contains numerous significant polymetallic volcanogenic massive sulfide (VMS) and gold–polymetallic pluton-related lode occurrences. To encourage renewed industry exploration for mineral deposits in this region, and to provide geologic data for State and local land-use management, the Alaska Division of Geological & Geophysical Surveys (DGGS) released a 613-square-mile airborne-geophysical survey for the eastern two-thirds of the area as part of the State-funded Airborne Geophysical/Geological Mineral Inventory program in 2007 (area shown in magenta; see figure). In the summer of 2008, DGGS conducted fieldwork to geologically map an approximately 200-square-mile area in the eastern Bonnifield mining district (area outlined in black; see figure). A geochemical data report will be published in early 2009, and 1:50,000-scale bedrock- and comprehensive-geologic maps will be published by the end of 2009. This project is primarily funded by State Capital Improvement Project (CIP) funds, with supplemental funding through the federal STATEMAP program.

The eastern Bonnifield map area is 60 miles south of Fairbanks in the northern foothills of the Alaska Range. The map area contains significant mineral occurrences, most notably the WTF and Dry Creek VMS prospects, which contain drill-inferred resources of Cu, Pb, Zn, Ag, and Au. Lithologic and structural relationships and interpretations depicted on existing, 50-year-old published geologic maps are not supported by our summer 2008 investigations. DGGS's new geologic map incorporates interpretations of our Bonnifield airborne geophysical survey data, aerial photographs, donated industry data, and our 2008 field observations. Our work documents many sets of newly discovered inactive faults and potentially one active fault, and contains a revised stratigraphic section based on actual lithologic units instead of grouped rock packages.



The primary objective of the eastern Bonnifield project is to map the geology in sufficient detail to facilitate wise State and local land-use decisions and to guide mineral industry exploration efforts. The timing of this project coincides with renewed mineral-industry interest in exploration for volcanogenic massive sulfide deposits including those in the eastern Bonnifield mining district; exploration activity in Alaska in general is at an all-time high. Because economic development could potentially come into conflict with other land uses, the availability of our detailed geologic, resource, and reconnaissance hazard assessments is important for long range planning. Providing a basic geologic framework and an inventory of potentially mineralized areas will help State and local planners balance the need for resource development versus other land-management strategies. Geologic maps and data produced by this project will also serve as a framework for further scientific studies and increased regional understanding of this tectonically active area, which is about 25 miles north of the Denali Fault system.

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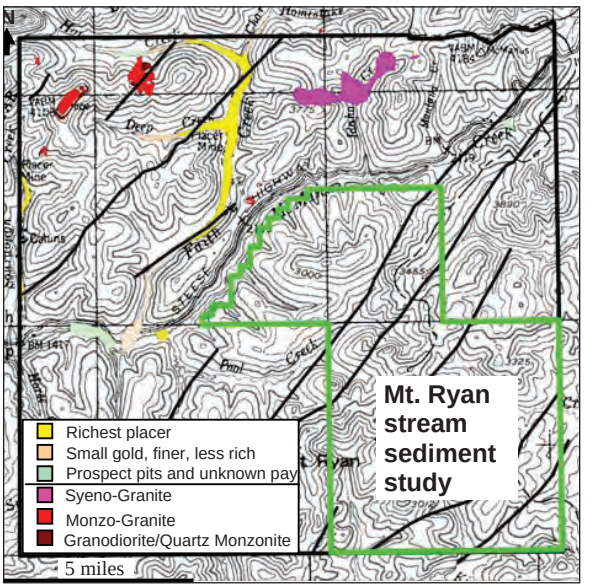
ALASKA GEOPHYSICAL/GEOLOGICAL MINERAL INVENTORY PROGRAM: BEDROCK GEOLOGIC MAPPING OF THE NORTHERN FAIRBANKS MINING DISTRICT, CIRCLE QUADRANGLE, NORTHEAST FAIRBANKS GEOPHYSICAL SURVEY TRACT

In the summer of 2007, the Alaska Division of Geological & Geophysical Surveys (DGGS) conducted about 189 square miles of geologic mapping northeast of Fairbanks, covering the central portion of DGGS's 404-square-mile Northeast Fairbanks airborne magnetic and electromagnetic geophysical surveys released in January 2006 (Burns et al., 2006). The mapping project is primarily funded by DGGS's Airborne Geophysical/Geological Mineral Inventory program, a special 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. Other funding sources include the federal STATEMAP program and the State's General Fund.

View, looking north, of the Faith Creek gold placer.

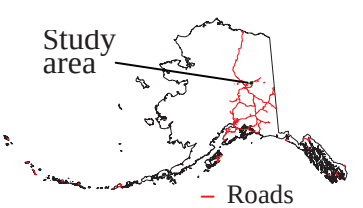
The Steese Highway bisects the study area from approximately highway miles 66 to 85. Good access from the highway, placer mining roads, and a few trails, in addition to nearby power from the high-voltage power lines of the Fort Knox gold mine located 25 miles to the southwest, would facilitate mineral development. The map area falls within a northeast-oriented trend of plutonic-related gold mineralization, located between the central and southwestern Fairbanks and the Circle mining districts. The Fairbanks mining district has the largest historic gold production in Alaska, with just less than 12.9 million troy ounces of gold produced as of 2007 (Szumigala et al., 2008). Three placer mines (two active) and one lode gold prospect occur within the Northeast Fairbanks map area (Freeman and Schaefer, 1998; D.J. Szumigala, oral commun., 2006). Placer gold is spatially associated with monzogranite and quartz monzonite plugs, dikes, and sills. The distribution of pay streaks within the placers (D.S.P. Stevens, oral commun., 2007) and paucity of mineralization within the intrusions suggest that some of the gold may be structurally controlled. In 2007, DGGS identified arsenopyrite-pyrite-quartz veins and boxworks and semi-massive stibnite-quartz veins proximal to the intrusive suite.

In addition to geologic mapping, DGGS conducted a rock and stream sediment geochemical study that was instrumental in Alaska's Division of Mining, Land & Water's decision to relocate a portion of the proposed Mount Ryan Remote Recreational Cabin Sites Staking Area to an area with lower perceived mineral potential. Because land opened to settlement is usually closed to mineral exploration and development, knowledge of an area's mineral potential is crucial to decisions on whether or not to retain that land for subsurface users. These geochemical data were published in January 2008.



Study area outlined in black. Black lines are faults.

DGGS's geologic mapping, which incorporates interpretations of our airborne geophysical data, will provide: (1) a better understanding of the lithologic, metamorphic, and tectonic framework of Interior Alaska, (2) baseline geologic-materials and hazards data for future construction of infrastructure and settlements, and the maintenance of current infrastructure, including the Steese Highway, (3) geologic-resource data critical to land-use decisions, and (4) geologic knowledge that will encourage mineral exploration investment in the northern section of the Fairbanks mining district. A series of 1:50,000-scale geologic maps and associated scientific studies for this project will be completed in early 2009. Surficial-geologic mapping performed in conjunction with this project is described separately.



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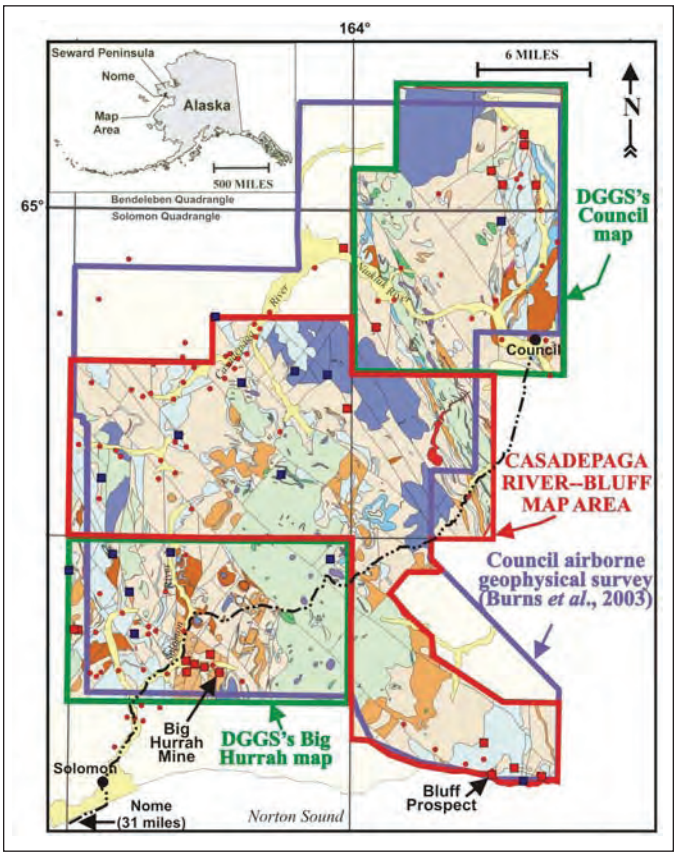
AIRBORNE GEOPHYSICAL/GEOLOGICAL MINERAL INVENTORY PROGRAM: GEOLOGIC MAPPING IN THE COUNCIL GEOPHYSICAL SURVEY TRACT

More than 1 million ounces of placer gold have been extracted from the Solomon–Council area of the Seward Peninsula of Alaska during the past century, but gold production has declined in recent decades. To encourage renewed industry exploration for lode gold and base-metal deposits in this region, and to provide geologic data for land-use management, the Alaska Division of Geological & Geophysical Surveys (DGGS) in 2003 released an airborne-geophysical survey for the area outlined in purple (see figure). This survey was part of the Airborne Geophysical/Geological Mineral Inventory (AGGMI) program, supported by state Capital Improvement Project (CIP) funds. In 2004, DGGS conducted 1:50,000-scale geologic mapping and geochemical sampling in the Big Hurrah and Council areas (green outline). In 2006, DGGS extended this mapping into the Casadepaga River–Bluff area (red outline), and will produce a combined map of the three regions by May 2010. A geochemical report for the 2006 map area was released in October 2007. This project is primarily supported by the CIP-funded AGGMI program, and was partially supported in 2007 by the federal STATEMAP program. The purpose of DGGS's mapping is to provide geologic context for known lode gold and base-metal deposits and occurrences, and evaluate the area's mineral resource potential. The Casadepaga River–Bluff map area contains the Bluff lode gold prospect, and covers the headwaters of the Casadepaga River, known for its rich placer gold deposits. The lode sources of this placer gold have not yet been identified.

The Casadepaga River–Bluff area is underlain by Proterozoic to Lower Paleozoic metasedimentary and metaigneous rocks of the Nome Group, including the Solomon Schist, Mixed Unit, Casadepaga Schist, and undifferentiated marble. DGGS's recent detailed geologic mapping defines the internal metamorphic stratigraphy of these rock units, and is revealing new relationships between units as well. Efforts to determine their depositional ages are in progress. Stratigraphic relationships and depositional-age data are essential for evaluating the economic potential of the Nome Group for hosting base-metal sulfide deposits.

In the Casadepaga River–Bluff area, DGGS's geologic mapping and associated studies have documented the location, geochemistry, age, distribution, orientation, and regional structural controls on the area's gold-bearing quartz vein systems. To help predict where additional veins may be located, it is important to determine the timing of gold-vein formation relative to structural features, metamorphic events, and igneous intrusions. Our preliminary work indicates that Nome Group rocks underwent high-pressure blueschist-facies metamorphism ~200 million years ago (Ma), and were later partially overprinted by a greenschist-facies mineral assemblage. Rare, extension-related alkalic intrusions of Cretaceous to Quaternary age are scattered throughout the map areas, but are not spatially associated with gold-bearing quartz veins. These veins yield $^{40}Ar/^{39}Ar$ adularia and white mica ages of ~105 to 115 Ma. Hydrothermal kaolinite, cinnabar, and adularia indicate epithermal-style mineralization on the southern Seward Peninsula, as well as the more widely distributed, gold-bearing veins of possible orogenic or extensional origin. Ongoing studies by DGGS and University of Alaska personnel will soon provide additional insights into the region's geologic, metamorphic, and structural history, and its lode-gold and base-metal mineral potential.



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BEDROCK GEOLOGY & MINERAL RESOURCES ALONG THE PROPOSED GAS PIPELINE CORRIDOR FROM DELTA JUNCTION TO THE CANADA BORDER

The Alaska Highway is the primary land transportation route to interior Alaska from the contiguous United States, and is likely to become the locus of increasing development, especially if the proposed natural gas pipeline or Alaska Railroad extension are constructed along this route. Despite the corridor's strategic location, relatively little geologic and geotechnical work has been published along its length. This multi-year project, supported by state Capital Improvement Project (CIP) funds, will provide a framework of geologic data upon which engineering, design, and resource decisions may be evaluated for future development between Delta Junction and the Canadian border. In 2006, as the first phase of this project, DGGS collected, interpreted, and published airborne geophysical data for a 16-mile-wide corridor centered on the Alaska Highway. The second phase of the project consists of mapping bedrock and surficial geology and evaluating geologic hazards and resources. The surficial-geology and geologic hazards parts of the project are described separately.

The bedrock portion of the project includes 1:63,360-scale bedrock geologic mapping and mineral-resource assessment work. In 2006 and 2007, DGGS conducted geologic field work between Delta Junction and Dot Lake, and in 2008, between Dot Lake and Tetlin Junction (figure 1). Although centered on the Alaska Highway, most of the 2008 field area was inaccessible by road; access was provided by helicopter, and along the Tanana River by kayak. The 2008 portion of the corridor is particularly significant because of its close proximity to the active Denali fault, located approximately 25 miles to the southwest in the Alaska Range. DGGS determined the location and kinematics of many smaller-scale faults related to the Denali fault system within the corridor, and this data will provide a better understanding of the history and potential impacts of these faults.

Our bedrock maps incorporate interpretations of DGGS's airborne magnetic and resistivity data, field data, and various scientific analytical data. The geophysical data is particularly valuable for interpreting the geology in areas covered by surficial deposits or vegetation. Preliminary results from 2008 field work (figure 1) show a continuation of geologic relationships determined by 2006-2007 field work, along with new features and interpretations. Numerous plutonic rock suites were defined; these plutons intruded metasedimentary and metaigneous rocks similar to those elsewhere in the Yukon–Tanana Uplands.

These rocks have undergone several ductile to brittle deformation and faulting events. High-grade contractional ductile deformation affects rock units as young as Mississippian. Normal faulting, accommodating east–west extension, affects rock units as young as Late Cretaceous. Overprinting all of this is a complex system of numerous younger strike-slip, reverse and oblique faults that have affected all of the rock units. These structures accommodate overall north–south contraction with a component of right-lateral slip, similar to deformation on the Denali fault. The latest structures may have been active during the Late Cenozoic due to their alignment with major topographic changes, and there are similar-azimuth lineations in young sedimentary units on aerial photographs and in DGGS's airborne geophysical data. In addition, there is evidence of Quaternary-age faulting along the northern front of the Alaska Range (see p. 49).

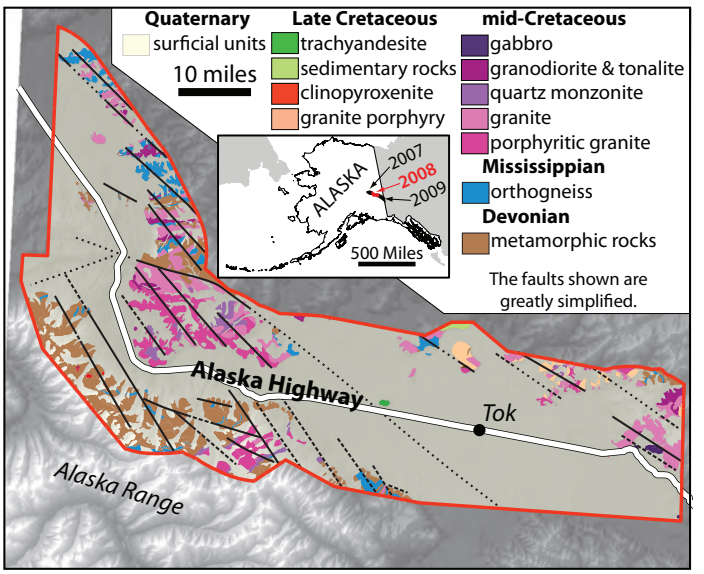

Figure 1. Preliminary bedrock geologic map of 2008 segment.

DGGS is also evaluating the mineral potential of bedrock units by sampling and analyzing altered rocks to provide baseline geochemical data for use by State land-use planners and mineral exploration companies. Geochemical analyses for 2008 field work will be published in early 2009. Bedrock geologic maps for the 2006–2007 and 2008 corridor segments will be published in late 2009. Funding for the Dot Lake to Tetlin Junction segment of mapping consists of FY2008 CIP funding. In the summer of 2009, continued bedrock mapping and mineral-resource evaluation from Tetlin Junction to the Canadian border will be supported by FY2009 CIP funding.

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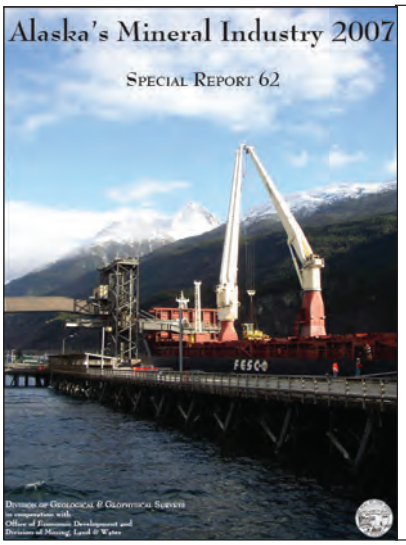
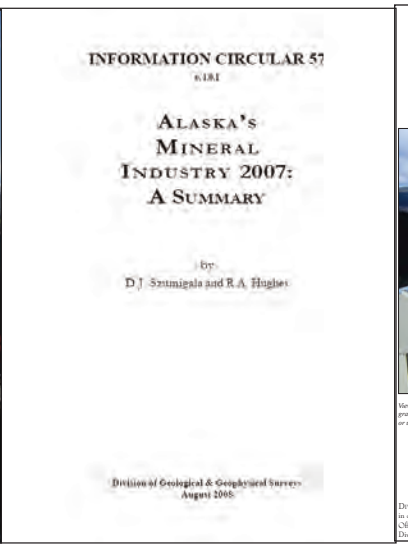
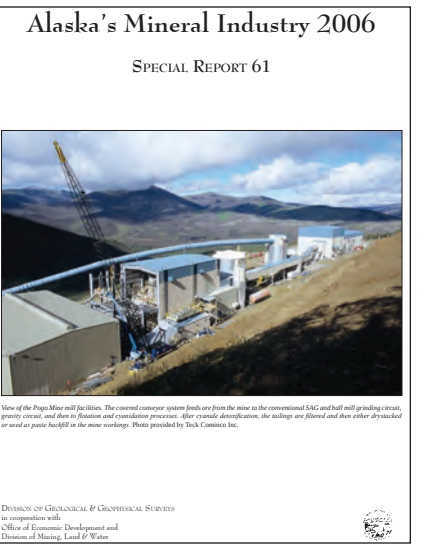
ANNUAL ALASKA MINERAL INDUSTRY REPORT







Alaska Statute 41.08 charges the Division of Geological & Geophysical Surveys (DGGS) *"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 and release this information in a timely manner 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 the State and the public with valuable information regarding the health of Alaska'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 exploration, development, and production of Alaska's mineral resources. Statewide and international circulation of the report and its findings at professional mineral industry conventions and trade shows, at chamber of commerce and other organizations' meetings, 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 Alaska's mineral industry. The report serves as a barometer for the mineral industry's status in any given year and provides unbiased, authoritative information compiled in a consistent format from year to year. Government personnel formulating public policy affecting resource and land management rely on the report as an essential tool.

The 2007 Alaska mineral industry report, released in November 2008, summarizes information provided through replies to questionnaires mailed by DGGS, phone interviews, press releases, and other information sources. The 2007 cumulative value of Alaska's mineral industry was $4.015 billion, a new record value. This was the first year that the cumulative value topped $4 billion and the twelfth straight year that Alaska's mineral industry topped $1 billion. Exploration expenditures for 2007 were $329.1 million, the highest expenditure total over 50 years of record keeping; development expenditures amounted to $318.8 million, the fourth highest total since records were kept in 1981; and the value of mineral production was $3,367.0 million, also a new record and more than double last year's value. The Alaska mineral industry value will likely be lower in all categories in 2008 due to lower commodity prices.

The annual report has been published for 26 consecutive years as a cooperative venture between the Department of Natural Resources' (DNR) Division of Geological & Geophysical Surveys, and the Office of Economic Development (OED) in the Department of Commerce, Community & Economic Development (DCED), with help from the Division of Mining, Land & Water (DMLW) in DNR. A summary of the 2008 Alaska mineral industry activities will be released by February 2009. The 2008 Alaska mineral industry report will be released by early November 2009.

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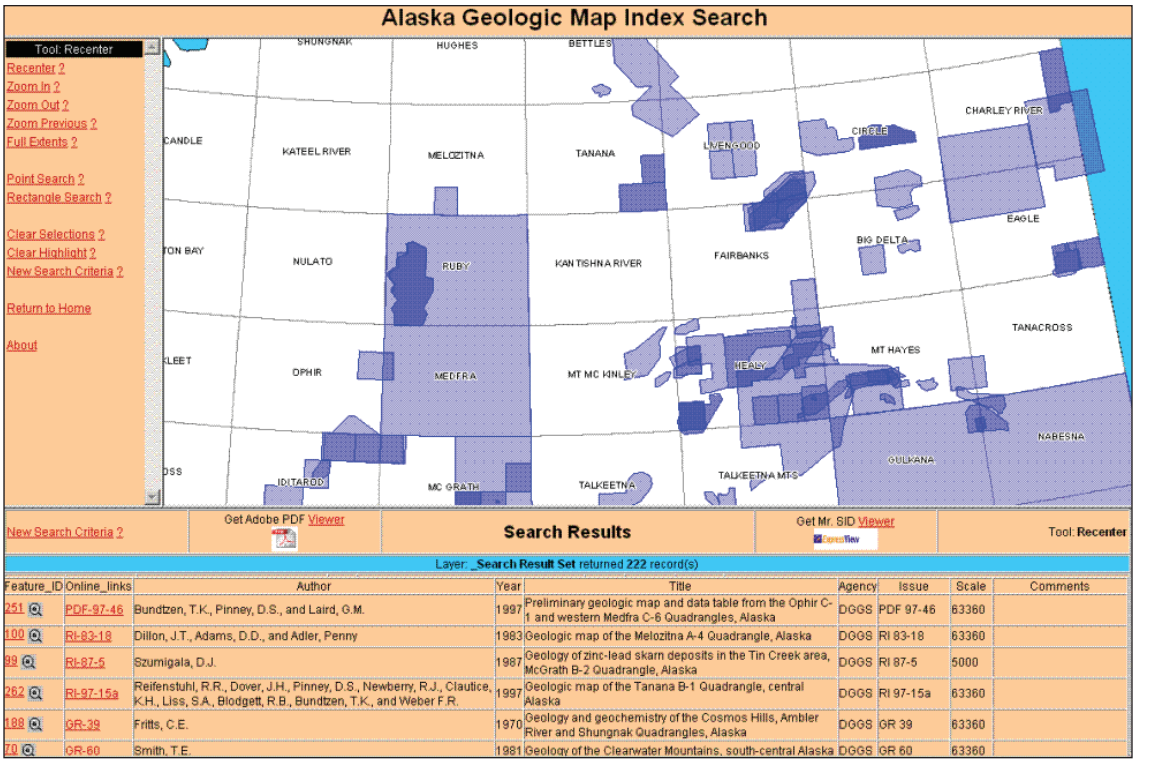
ALASKA GEOLOGICAL AND GEOPHYSICAL MAP INDEX

The Alaska Department of Natural Resources, Division of Geological & Geophysical Surveys (DGGS) and Land Records Information Section (LRIS) released the first version of a Web application that portrays the locations and outlines of geologic maps from all government agencies in a single, interactive, Internet-accessible location. The "Alaska Geology Map Index" site 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 most Alaskan 1:250,000- and 1:63,360-scale geologic maps produced by the U.S. Geological Survey (USGS) and more DGGS maps will be added by the end of August, 2009. LRIS will then modify the interface for the "Alaska Geology Map Index" website to enable users to refine the searches. When that modification is completed, DGGS will add outlines for remaining geologic maps by DGGS, USGS, U.S. Bureau of Mines (BOM), and U.S. Bureau of Land Management (BLM) and geophysical maps by DGGS and other agencies in future years.



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 purpose of the Alaska Geology Map Index project is to make information about the current status of bedrock and surficial geologic mapping of Alaska widely accessible to the mineral industry and others, and to provide an effective means of searching for maps of interest. Currently, an up-to-date map index of DGGS, USGS, BLM, and 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 project was initiated with funding from the federal Minerals Data and Information Rescue in Alaska (MDIRA) program and is now supported by state General Funds. 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.

Besides allowing searching by rectangle or by point, the current interface (shown above) provides links to scanned reports and maps for each DGGS citation. Links to scanned USGS publications, available at DGGS's website (http://www.dggs.dnr.state.ak.us), will be provided when they have been included in the Map Index website. Subsets of map outlines based on map categories, such as "bedrock geology," "surficial geology," "resources-metals, lode," and "hazards, permafrost" may also be retrieved by the user through another associated Web page.

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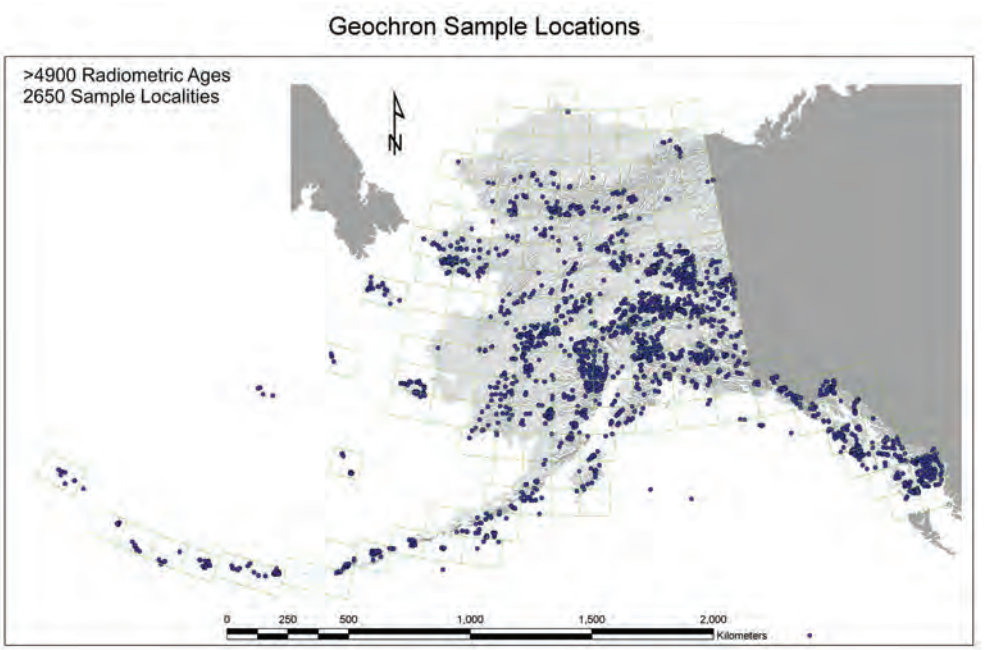
GEOCHRONOLOGIC DATABASE FOR ALASKA

In 2005, the Alaska Division of Geological & Geophysical Surveys (DGGS) began to develop a geochronologic database for Alaska. The geochronologic database 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 was initiated as part of the federally funded Minerals Data and Information Rescue in Alaska (MDIRA) program and is now supported by state General Funds. The primary objective of the MDIRA program is to ensure that all available Alaska minerals data are preserved in a safe and readily accessible format for all potential users. Information on mineral resources is important 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 was used as a starting point for the structure of the geochronologic database. Additional fields were added after consulting laboratory analysts and other geologists interested in using the database. The database will include data for all available U-Pb, K-Ar, $^{40}Ar/^{39}Ar$, and Rb-Sr dates for Alaska. Previous compilations by Wilson and others provided the initial source of age data for the database. Additional radiometric dates are being compiled from both published and unpublished sources. In addition to updating existing compilations, this database project is adding essential basic supporting information that is currently not easily accessible. This information includes details 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, the missing information or permission to use unpublished information was requested from appropriate geologists. The American Geological Institute's GeoRef database and a dataset currently under construction at DGGS, the Bedrock and Surficial Geologic Map Index, are being used to search for additional sources of data.

This geochronologic database provides a centralized, up-to-date, digital source of radiometric ages. 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. To date, more than 4,925 age records have been entered into the database. The final stage of the geochronology project will be to make this database accessible via DGGS's website and through a link on the MDIRA website (http://akgeology.info). Bibliographic citations for DGGS and U.S. Geological Survey publications will be linked to digital or PDF files of the appropriate publication. A release of the geochronologic database is scheduled for 2009. The completed database will reside in DGGS's Oracle database, which will serve as a repository for future radiometric data.



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ARCHIVING AND INDEXING DGGS PROJECT FILES AND FIELD NOTES (DGGS LEGACY FILES PROJECT)

The purpose of the Alaska Division of Geological & Geophysical Survey's (DGGS) Legacy Files project is to organize, catalog, and index DGGS legacy projects and field data accumulated over the past 40 years. This project is funded through the federal Minerals Data Information Rescue in Alaska (MDIRA) program, and is a joint effort between DGGS and the Department of Mining and Geological Engineering at the University of Alaska Fairbanks (UAF). Through a Reimbursable Services Agreement, UAF principal investigators managed hiring of UAF students to assist with the project. Several UAF geological engineering students were employed over parts of the past five years, and 4 DGGS staff members worked part-time on the project. The successful MDIRA-sponsored Alaska Mineral Information Data Index (AKMIDI) project model, used to inventory similar private data collections in previous MDIRA-funded projects, was used as a template.

DGGS has boxes and file cabinets full of project maps, files, field notes, associated data, unpublished reports, thin sections and rocks accumulated by staff geologists during the past 40 years. These items were not previously indexed and archived due to lack of time and funding. This current indexing project enabled DGGS to organize, inventory, and store legacy documents to make them accessible to DGGS scientists and the public. Tasks were split into two components: Organizing, scanning, and archiving maps; and organizing associated project files and rock samples.

Historic project and field data were sorted, bar coded, and indexed using a variation of the AKMIDI relational database. The bar code index will ultimately be uploaded into the DGGS Oracle database. The database will be amenable to routine maintenance and query and will provide DGGS with an opportunity to make an organized index of its archived project file materials available to the public through the Internet. All minerals-related maps were sorted, bar coded, and filed into drawers in the DGGS map room.

Approximately 30 file cabinets of project files, manuscripts, field maps, field notes, and other products from legacy projects have been partially sorted and inventoried. A spreadsheet of over 8,800 historic thin sections has also been completed. Indexed project and working file data and materials will be stored in an organized manner so that they are accessible and archived for the future. The inventoried documents will be stored in DGGS offices.

More than 40 pallets of partially archived rock samples were moved from cold storage into the DGGS warehouse for cataloging, boxing, and shipping to the Alaska Geologic Materials Center (GMC) in Eagle River. Two shipments of legacy samples totaling 11 tons were shipped to the GMC in 2008. Another several-ton shipment of legacy geochemical samples is expected to be shipped by mid 2009 after indexing and re-boxing. All rock samples shipped to the GMC will be accompanied by a relational database, which records as much information as is known for each rock sample, including sample ID, collector name, project name, and sample location if known (spatial coordinates and/or quadrangle). The project will be completed before federal funding expires in September 2009.

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SURFICIAL GEOLOGY OF THE NORTHERN FAIRBANKS MINING DISTRICT, CIRCLE QUADRANGLE, NORTHEAST FAIRBANKS GEOPHYSICAL SURVEY TRACT

In summer 2007, the Division of Geological & Geophysical Surveys (DGGS) conducted about 189 square miles of geologic mapping northeast of Fairbanks, covering the central portion of DGGS's 404-square-mile Northeast Fairbanks airborne magnetic and electromagnetic geophysical survey area. The mapping project was primarily funded by DGGS's Airborne Geophysical/Geological Mineral Inventory program, a special multi-year capital-project 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. Other funding sources included the U.S. Geological Survey's STATEMAP program and the State's General Fund.

The Engineering Geology section of DGGS mapped the surficial geology of the area to understand the genesis of the landscape in which placer gold deposits have accumulated (fig. 1). Glacial deposits are prominent in the northwestern portion of the field area, where large granite erratics can be traced many kilometers downvalley from sources in the high peaks of the Mt. Prindle area. Extensive gravel-capped, high-level terraces are preserved along the Chatanika River, and extend upvalley into the lower reaches of major tributary streams in the western portion of the field area. Thin lags of rounded fluvial cobbles are draped on discontinuous remnants of these high-level terraces as far as 10 kilometers upstream in Faith Creek. Silt-dominated deposits characterized by numerous pingos predominate in the southern part of the study area.

The products of this project are geologic-framework maps at 1:50,000 scale, one of which describes the surficial geology of the area. The map is currently being revised after technical review and will be released in spring 2009. We are using the DGGS Geographic Information System (GIS) to generate these maps, and all data for the project will ultimately be stored and made available in a geographically referenced relational database. DGGS will serve these data on the Worldwide Web upon completion of the project. Past experience has shown that a thorough understanding of the geologic framework of an area acts as a catalyst for resource development, paves the way for future exploration, and fosters improved resource management and land-use planning. We anticipate a similar result in the Northeast Fairbanks geophysical tract.

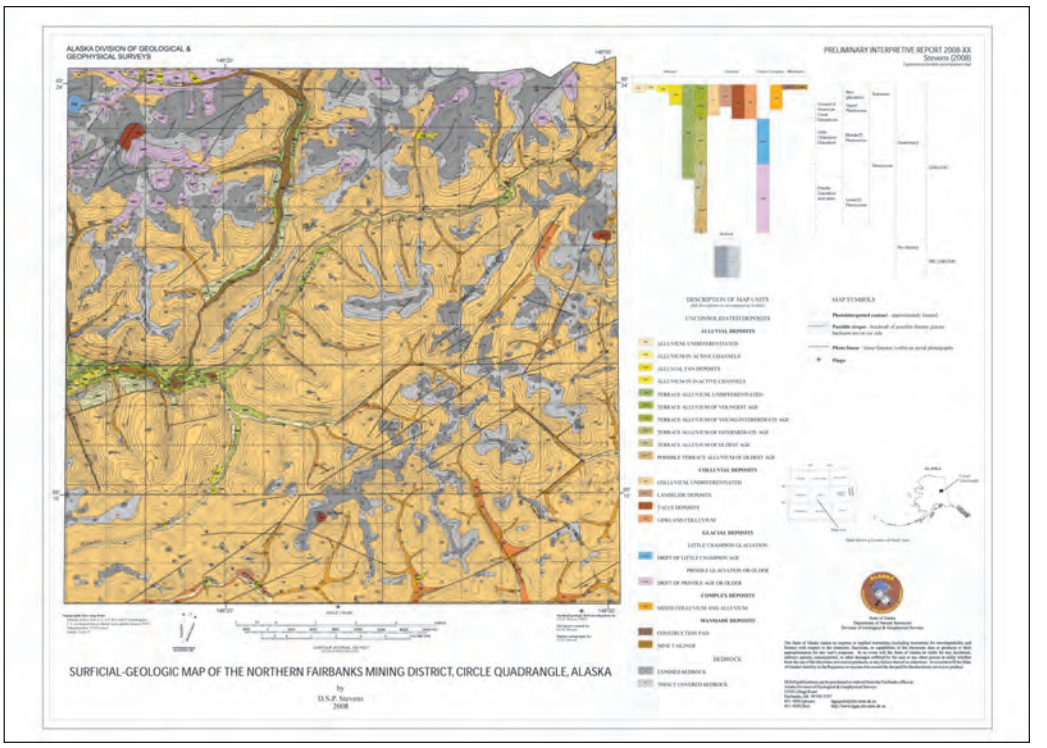

Figure 1. Draft surficial-geologic map of the northern Fairbanks mining district

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GEOLOGY, GEOHAZARDS, AND RESOURCES ALONG THE PROPOSED GAS PIPELINE CORRIDOR, ALASKA HIGHWAY FROM DELTA JUNCTION TO THE CANADIAN BORDER

The proposed Alaska natural gas pipeline from Prudhoe Bay to the lower 48 promises to be the largest construction project ever in North America. Reliable objective geologic data for the proposed route is a high priority for the state in order to provide a framework of information upon which engineering, design, and permitting decisions may be based. The Alaska Highway corridor, between Delta Junction and the Canadian border, is the one portion of the proposed gasline route that is not occupied by the trans-Alaska oil pipeline. Therefore, far less geologic information has been published along this corridor. The Alaska Division of Geological & Geophysical Surveys (DGGS) has been conducting a multi-year project that will provide surficial-geologic maps, bedrock-geologic maps, engineering-geologic maps, and interpretive permafrost maps and reports on active and potentially active faulting along a 12-mile-wide corridor following the Alaska Highway. The bedrock-geology part of this project is described separately (see p. 43).

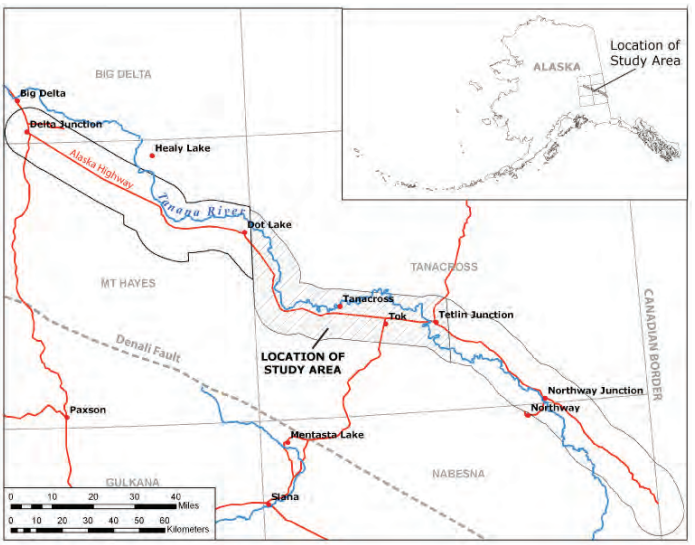

Figure 1. Location of the Dot Lake to Tetlin Junction map area.

Collecting, interpreting, and publishing airborne geophysical data was the first phase of DGGS's Alaska Highway gas pipeline corridor project. Using the geophysics as a starting point, DGGS began geologic mapping and geohazards evaluation in the Alaska Highway corridor in 2006, working southeast from Delta Junction. In 2007 we completed field work from Delta Junction to the eastern border of the Mount Hayes Quadrangle near Dot Lake. Resulting maps and reports from this work continue to be published in 2008.

In 2008, DGGS continued the project to the southeast, collecting geologic field data from the corridor between Dot Lake and Tetlin Junction. Surficial-geologic and permafrost investigations focused on ground-truthing aerial photograph interpretive mapping that was completed prior to field work. Our observations led to a better understanding of the origin, timing, and characteristics of unconsolidated surficial deposits. Results will be published in 2009 as surficial-geologic maps and interpretive engineering-geologic and permafrost maps at a scale of 1:63,360. Derivative maps based on the surficial geologic map units will describe the engineering characteristics to be expected in each landform.

Our investigation of active and potentially active faults followed reconnaissance studies of observed lineaments in and projecting into the corridor. We dug eight trenches across suspected fault scarps to determine whether there was evidence of fault activity in the exposed deposits. Of the eight trenches, three proved not to be the result of active fault movement, and one yielded inconclusive results. The other four trenches revealed evidence of recent fault activity, extending the observed length of the Dot "T" Johnson thrust fault. The Dot "T" Johnson fault, identified by this project in 2007, roughly parallels the northern front of the Alaska Range along the Alaska Highway in the study area and shows evidence of multiple paleoseismic events within the last 10,000 years.

Figure 2. DGGS geologist Trent Hubbard inspects unconsolidated surficial deposits in a material site on the Tok fan. Large boulders interspersed with gravel were deposited during glacial outburst flooding out of the Tok River valley.

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SURFICIAL GEOLOGY IN THE SAGAVANIRKTOK QUADRANGLE, NORTH SLOPE, ALASKA

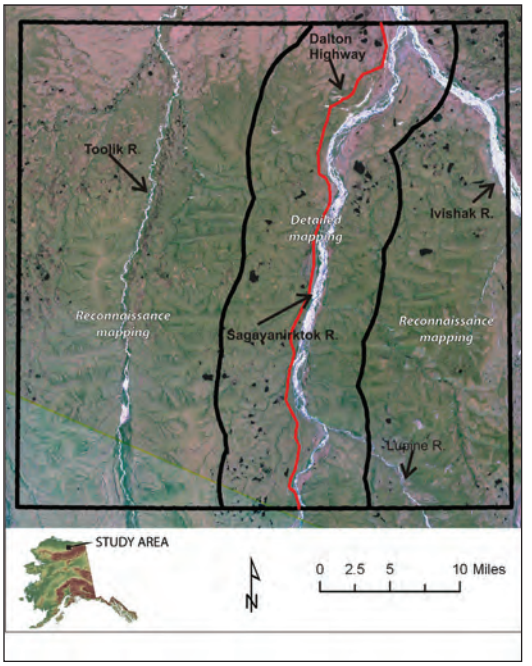

Figure 1. Landsat image showing surficial geologic mapping area.

In the summer of 2008 the Alaska Division of Geological & Geophysical Surveys (DGGS) conducted field work for 1:50,000-scale surficial and bedrock geologic mapping of a 1,212-square-mile area centered approximately along the Dalton Highway and Trans-Alaska Pipeline (TAPS) corridor in the northern foothills of the Brooks Range of Alaska (figure 1). This project, supported in part by the U.S. Geological Survey's STATEMAP program, is part of ongoing work by DGGS to geologically map the northern foothills of the Brooks Range (see p. 34). With the potential for building a natural gas pipeline and continued resource exploration, geologic mapping in this area will aid in location of sand and gravel resources needed for road maintenance and will provide important planning information for infrastructure development. Results of this project will also aid in the identification of potential geologic hazards such as slope creep, melting permafrost, and flooding. Additionally, with increasing concern about potential impacts of climate change, it is important to have basic geologic information in areas of abundant permafrost that can be used in assessing environmental change.

The area being mapped includes portions of the Toolik, Sagavanirktok, Lupine, and Ivishak River drainages (figure 1). Surficial materials consist of colluvial and periglacial deposits as well as deposits associated with glacial advances from the south, mainly along major river valleys. The northern parts of the map area are characterized by uplands and older glacial deposits. Colluvial and periglacial processes dominate, resulting in soliflucted slopes, thermokarst lakes, and features associated with extensive permafrost. In many cases landscape modification is so extensive that evidence of past glaciation can only be documented by the presence of erratic boulders of highly resistant Kanayut Conglomerate, which is found in outcrop outside the study area. In areas of younger glacial deposits to the south, erratic boulders are more abundant, less weathered, and have greater protrusion above the surrounding surface. In general, the topography in these southern areas has been less modified by colluvial and periglacial processes and it is easier to identify primary glacial deposits and landforms (figures 2 and 3).

The anticipated products from this project are two 1:50,000-scale maps in digital and hard copy formats, to be published in 2009. A detailed map will encompass a 10-mile-wide corridor centered along the Trans-Alaska Pipeline totaling 377 square miles, and a reconnaissance-level map will include this area and 835 additional square miles extending from west of the Toolik River east to near the Ivishak River. The project will utilize Geographic Information System (GIS) to generate maps and data that will be made available in a geographically referenced relational database. Upon completion of this project DGGS will make the maps and data available for download on its website.

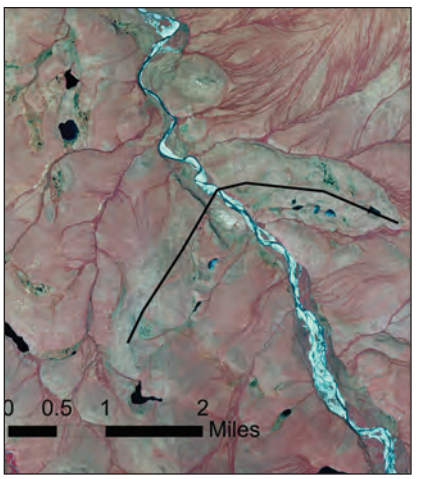

Figure 2. Air photo showing Itkillik-age moraine along the Lupine River. Black line marks the moraine's crest.

Figure 3. Itkillik-age moraine. (Tom Hamilton, USGS, walking to the north)

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ALASKA COASTAL MANAGEMENT PROGRAM: NATURAL HAZARDS

DGGS provides support to Alaska Coastal Management Program (ACMP) personnel and coastal district planners regarding natural hazard issues. DGGS responsibilities include: Reviewing natural hazard aspects of proposed coastal projects during the consistency review process; recommending state designation of hazard areas during consistency reviews when needed; providing support to coastal district planners in revising coastal management plans; participating in district teleconferences; and periodically reviewing regulatory and planning documents regarding natural hazards issues.

The DGGS website provides access to a Natural Hazards Bibliographic Database for Alaskan Coastal Districts, including links to scanned DGGS and USGS publications containing information relevant to hazard identification in Alaska. The Natural Hazards Bibliographic Database is served from DGGS's publications database and is searchable by coastal district at http://www.dggs.dnr.state.ak.us/geologic_hazards_coastal_districts.htm.

A lack of basic field data and baseline information on geologic hazards in Alaska makes it difficult for coastal districts and the State to implement the ACMP natural hazard standard (11 AAC 112.210). Coastal districts often do not have the scientific information needed to designate natural hazard areas in their district plans for the purpose of ensuring that coastal development adequately mitigates the risks of the hazards. During consistency review for a proposed project, the State can, under the standard, designate a natural hazard area so that hazards risks may be addressed in the review. DGGS assists DNR in development of the background information and formal designation of the hazard area. The ACMP is currently undergoing re-evaluation and DGGS has been tasked with rewriting the hazards standard to reflect lessons learned from implementation of the previous standard.

Photograph of Hawk's Beach, Alaska, where DGGS was instrumental in designating a natural hazards area so hazards risks could be addressed as part of the ACMP review of proposed development projects.

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ASSESSMENTS OF GEOLOGIC HAZARDS ASSOCIATED WITH CLIMATE CHANGE

Alaska's high latitude makes it particularly sensitive to the effects of a changing global climate. This sensitivity has led such widely-read national publications as USA Today to call Alaska the 'poster state' for climate concerns. Many believe these climate changes will have a direct effect on Alaskan communities and infrastructure, as well as on the livelihoods and lifestyles of Alaskan citizens, through increased geologic hazards such as coastal and riverbank erosion, flooding, and thawing permafrost (figure 1). Although some effects of these processes may be due to improper design and not climate change (as may be the case in figure 1), studies have shown that permafrost near the current southern margin of its extent is degrading, and that a northward shift of hundreds of kilometers is anticipated in this boundary if climatic warming trends continue. As early as 1998, the Bering Sea Impact Study (BESIS) evaluated the economic impact and consequences of global climate change on Alaska's infrastructure as part of the U.S. National Assessment and concluded that "much of the damage to infrastructure … —roads, transportation, etc.—could be avoided through adequate planning and public policy." It is important that the State help preserve the health and safety of Alaska's people by being prepared for potential emergency situations resulting from geologic hazards that are caused or amplified by climate change, and to perform the necessary sound science to identify high-risk areas where proactive mitigation efforts will be needed and useful (figure 2). These new data will also be critical to identify areas where design structure and proper, informed planning can alleviate the need for future mitigation.

Figure 1. Thaw settlement of a paved bike path near Fairbanks, Alaska. Climate change may amplify thermokarst development as permafrost becomes warmer. Photo by State of Alaska Department of Transportation (DOT).

The Division of Geological & Geophysical Surveys (DGGS) is beginning a focused effort to prioritize, map, and publish geologic-hazards information that will be used for proactive planning, mitigation, and emergency response in high-risk communities and developing areas. This effort will be performed in collaboration with relevant outside organizations that may include the University of Alaska Department of Mining and Geological Engineering, the Federal Emergency Management Agency (FEMA), the Alaska Division of Coastal & Ocean Management (DCOM), the Alaska Department of Commerce, Community and Economic Development (DCCED), and the U.S. Army Corps of Engineers (COE), and will provide valuable information to allow planners and design engineers to minimize the economic impacts and public safety risks associated with geologic hazards.

DGGS will collect the necessary field data to produce and publish peer-reviewed surficial and geologic-hazards maps and reports of high-risk Alaskan communities, prioritized in consultation with DCCED staff and coastal districts, FEMA, COE, and local governments. Maps may include proposed community relocation sites. Mapping will be completed at local and/or regional scales as needed to address specific local problems and to understand and evaluate the larger geologic context. The geologic-hazards maps will be published in digital GIS format in conformance with national standards and will delineate areas where potential natural hazards such as erosion, slope instability, flooding, and thawing permafrost should be considered at a more detailed level to fully evaluate risk for any given use. DGGS expects to complete the first products of this project in FY2010.

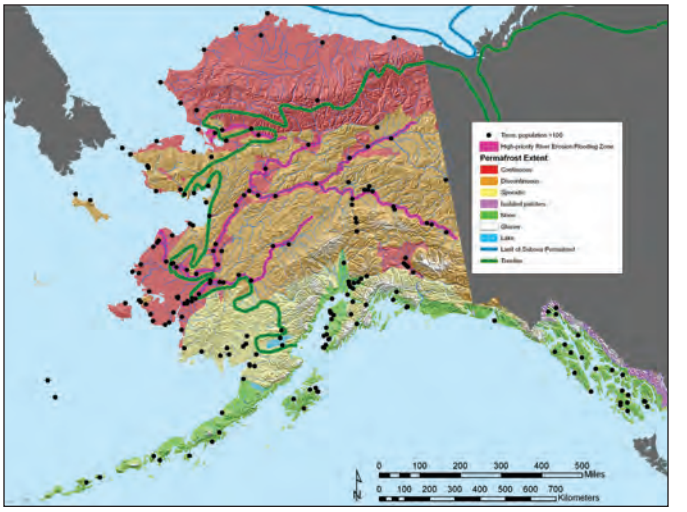

Figure 2. Map showing the distribution of permafrost and major river erosion and flooding zones in Alaska with respect to communities with populations of greater than 100 people. Along with coastal flooding and erosion, these natural processes and phenomena are likely to be affected or amplified by climate change.

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GEOHAZARD EVALUATION AND GEOLOGIC MAPPING FOR COASTAL COMMUNITIES

Approximately 6,600 miles of Alaska's coastline and many low-lying areas along the state's rivers are subject to severe flooding and erosion. The United States General Accounting Office (GAO; now the U.S. Government Accountability Office) reported in 2004 that flooding and erosion affects 184 out of 213 (86 percent) of Alaska Native villages, and most of these are coastal communities (figure 1). Many of the problems are long-standing, although some studies indicate that increased flooding and erosion is being caused in part by changing climate. The GAO found that four villages—Kivalina, Koyukuk, Newtok, and Shishmaref—are in imminent danger from flooding and erosion, and planning is underway to relocate these villages farther inland. Of the top four at-risk villages, all but Koyukuk are coastal communities. These findings were reinforced in 2006, when the U.S. Army Corps of Engineers determined that the coastal villages of Kivalina, Newtok, and Shishmaref have only 10–15 years left in their current locations before being irretrievably lost to erosion if countermeasures are not implemented (figure 2).

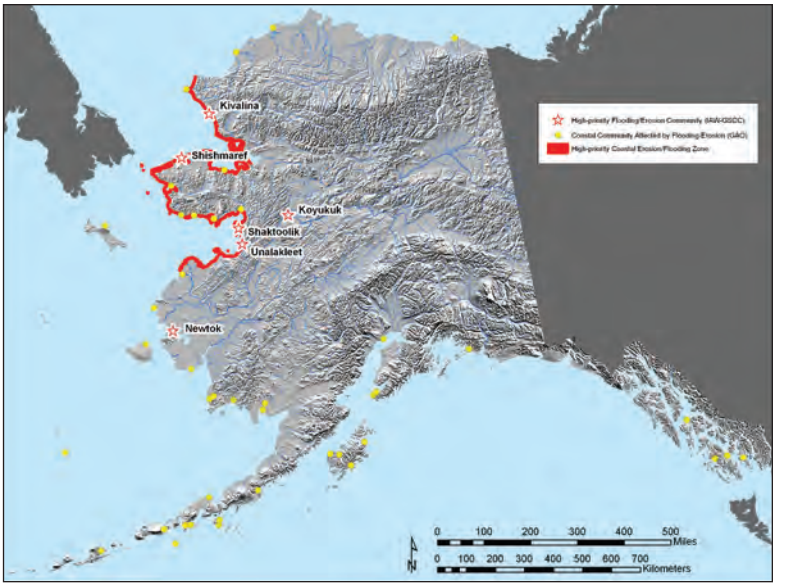

Figure 1. Map showing the distribution of Alaskan communities at risk for coastal flooding and erosion.

Figure 2. Kivalina during a 2006 storm, with distances measured between structures and the eroding coast. The U.S. Army Corps of Engineers estimates that this village may be irretrievably lost to erosion within 10–15 years. Photo by State of Alaska Department of Environmental Conservation (DEC).

In response to these issues, DGGS is initiating a coastal community geohazards evaluation and geologic mapping program in support of community and district planning. External support for this effort comes from the federal U.S. Minerals Management Service (MMS) as part of the Coastal Impact Assistance Program. Beginning in summer of 2009, we will collect the necessary field data to produce and publish surficial and engineering-geologic/hazards maps of Alaskan coastal communities, prioritized in consultation with the Alaska Division of Community and Regional Affairs, Alaska Coastal Management Program staff, the U.S. Army Corps of Engineers (COE), and affected coastal districts. The maps will identify local natural hazards that must be considered in the siting, design, construction, and operations of development projects to ensure protection of human life, property, and the coastal environment. Maps may include proposed relocation sites in response to the severe coastal erosion problems now facing various Alaskan communities. Mapping will be completed at local and/or regional scales as needed to address specific local problems and to understand and evaluate the larger geologic context of the area. The engineering-geologic/hazards maps will be published in GIS format with standard metadata and will delineate areas where natural hazards such as erosion, slope instability, active faults, flooding, and earthquake effects should be considered at a more detailed level to fully evaluate construction risk and to ensure that the coastal areas are not damaged by planned and proposed development. Project work will be coordinated with current U.S. Geological Survey coastal studies to ensure there is no duplication of effort. DGGS expects to complete the geohazard evaluation and hazard mapping for one community in FY2010 and one or two communities in each of the following three years.

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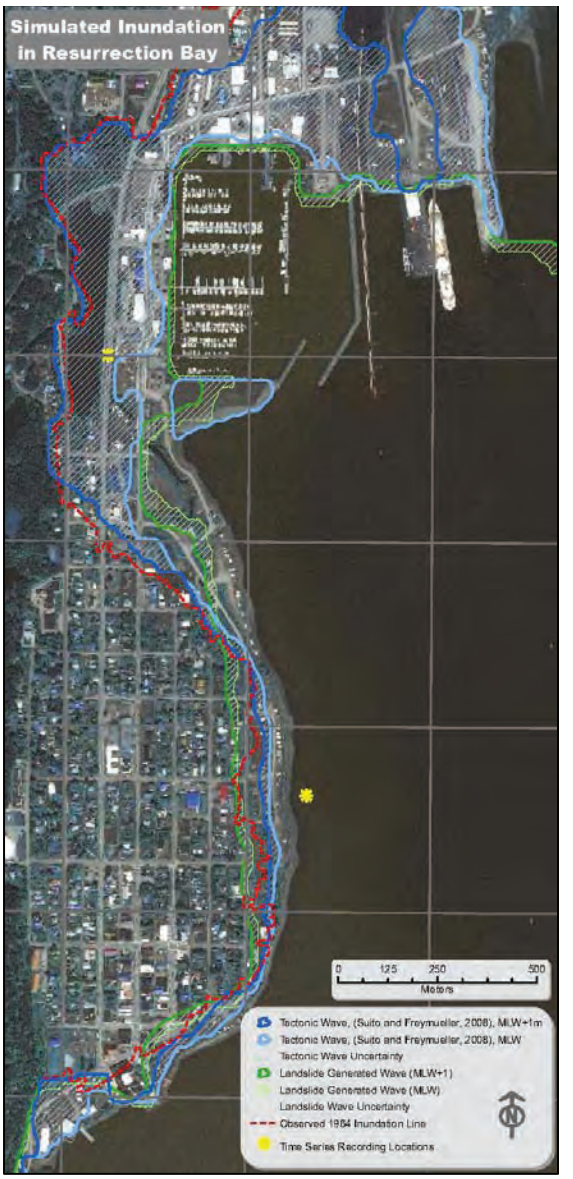
TSUNAMI INUNDATION MAPPING FOR ALASKA COASTAL COMMUNITIES

With funding from Congress, the National Oceanic & Atmospheric Administration (NOAA) initiated the National Tsunami Hazard Mitigation Program in 1997 to assist Pacific states in reducing losses and casualties from tsunamis. The program included 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. In 2005, following the catastrophic Sumatra earthquake and tsunami, the U.S. program was expanded to include Atlantic and Gulf of Mexico states and territories.

As part of this program, DGGS participates in a cooperative project with the Alaska Division of Homeland Security & Emergency Management (DHSEM) and the University of Alaska Geophysical Institute (UAGI) to prepare tsunami inundation maps of selected coastal communities. Communities are selected on the basis of tsunami risk, infrastructure, availability of bathymetric and topographic data, and willingness of a community to use results for emergency preparedness. For each community, DGGS and UAGI develop multiple hypothetical tsunami scenarios that are based on the parameters of potential underwater earthquakes and landslides. We have completed and published tsunami inundation maps for the Kodiak area as well as for Homer and Seldovia. For the next community, Seward, we have compiled and merged bathymetric and topographic data and are conducting numerical wave modeling for tsunamis generated both tectonically and by submarine landslides (see figure). Tsunami inundation maps and a report for Seward will be published in 2009. Data compilation and inundation modeling for the next community, Sitka, are underway.



Draft tsunami inundation map for Seward, Alaska.

To develop inundation maps, we use 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 conducts the wave modeling using facilities at the Arctic Region Supercomputing Center. DGGS, UAGI, and DHSEM 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.

We have presented results of this project at international tsunami symposia in Istanbul, Turkey, Seattle, Washington, and Hania, Greece, at the Tsunami Society symposium in Honolulu, Hawaii, at the International Union of Geodesy and Geophysics Symposium in Perugia, Italy, and at the American Geophysical Union annual meetings in 2003 through 2007. In addition, this project has been the subject of articles in *Geotimes* and *TsuInfo Alert Newsletter*.

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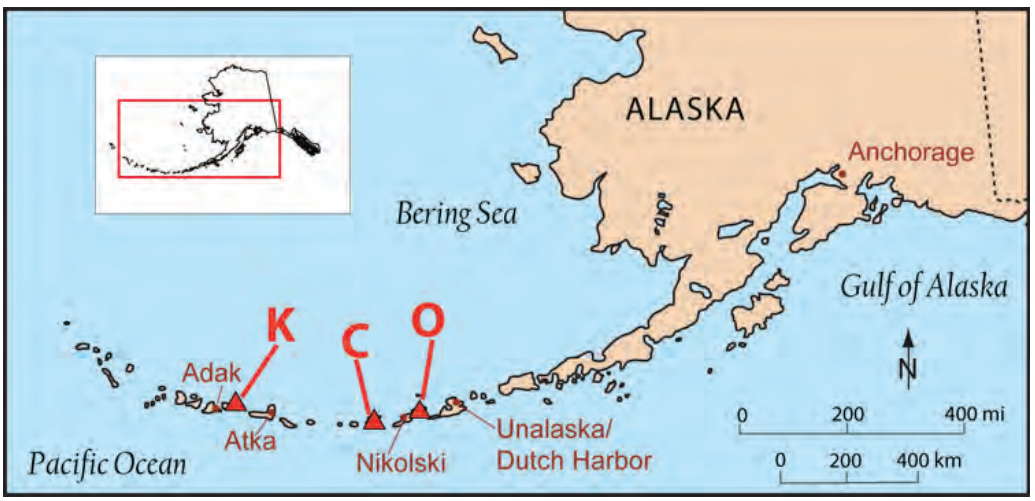
RESPONSE TO 2008 VOLCANIC ERUPTIONS

For the first time in recorded history there were three simultaneous major eruptions at Alaska volcanoes. Alaska Volcano Observatory (AVO) staff estimate that the annual probability of three large simultaneous eruptions is one in a thousand (i.e., this was a "thousand year event").



Location of Kasatochi, Cleveland, and Okmok volcanoes in Alaska. K=Kasatochi; C=Cleveland; O=Okmok. Selected Alaska towns and features are also displayed.

Okmok Volcano erupted explosively, and with virtually no warning, starting on July 12, 2008, sending ash to 50,000 feet. During the following five and a half weeks of nearly continuous eruption residents of Nikolski were stranded for periods of up to three weeks; Unalaska (65 miles northeast) was repeatedly dusted with ash and flights into and out of this major fishing hub were frequently disrupted; floating rafts of scoria and low visibility prompted the Coast Guard to close Umnak Pass to marine traffic; and the Bering Pacific cattle ranch on the flanks of Okmok was periodically evacuated, once during noon-time darkness caused by heavy ash fall.

Photograph of Okmok in eruption taken August 2, 2008, by Janet Schaefer (DGGS/AVO). This eruption is from a series of new vents near the old Cone D.

AVO fieldwork at Okmok (including DGGS geologist Janet Schaefer) during and after the eruption confirmed that the eruption took place at a new vent in the northeast part of the caldera, creating a roughly 800-ft-high cone, dramatically altering caldera hydrology, and discharging huge lahars, or volcanic mudflows, running from the caldera to the coast. In contrast, all 20th century eruptions have been from a cone near the southern rim of the caldera. The 2008 eruption was by far the largest eruption at Okmok since at least the early 19th century.

Cleveland Volcano plume on August 1, 2008 (eruption began July 21), as seen from a plane 17.5 nautical miles east-southeast of the volcano, at an altitude of 8550 feet. Photograph taken by Shawn Dahle, National Oceanic and Atmospheric Administration, National Marine Mammal Lab.

On July 21 AVO received reports from fishing vessels of an eruption at **Cleveland Volcano** (see index), which is not monitored by seismic instruments. Residents in Nikolski (45 miles east) also heard the eruption and reported light ash fall. Although Cleveland (and surrounding islands) are uninhabited, at this time a group of Russian ham radio operators and a local radio reporter were camped on the eastern end of the island. Their supporting ship from Unalaska was anchored nearby. Their eyewitness reports of the sound of the eruption and the thickness of ashfall helped AVO in its response. Satellite imagery confirmed ash plumes to ~20,000 feet. A lava flow began forming on July 21, and explosive ash emission continued until July 29. Small eruptions of Cleveland are relatively common—this eruption was the largest in several years.

Photo of southwest flank of Kasatochi island, taken August 23, 2008, after the eruption of August 7. The cliff-like feature that rims the island is the former shoreline. Photograph taken by Chris Waythomas, USGS/AVO.

On August 4 AVO was notified that the two-person U.S. Fish and Wildlife Service field crew on **Kasatochi Island** was feeling frequent small earthquakes. Kasatochi is a very remote, unmonitored and uninhabited island in the Aleutians. It is 1.5 by 1.8 miles across, with a 0.75-mile-diameter crater, and had no confirmed historical eruptions prior to 2008. Seismicity escalated rapidly in magnitude and number over the next few days, with a magnitude 5.6 earthquake closely followed by the onset of tremor strong enough to be detected 26 miles to the west, in turn followed closely by three strong explosive eruptions and ash emission for about a day. Fortunately, the field crew was evacuated shortly before the explosive onset. The eruption sent ash to elevations of about 50,000 feet; produced the largest volcanic sulfur dioxide cloud worldwide since 1991 (Hudson); and produced an ash cloud that drifted to the west into the air routes connecting Alaska with the lower 48, prompting the cancellation of 40 flights and disrupting travel for at least 5,000 people. The eruption cloud subsequently circled the globe, producing vivid sunsets in the lower 48 states and Europe. On the island itself pyroclastic flows swept all flanks, extending the shoreline by a quarter of a mile, killing or covering all plants and killing or displacing all animal life, including the hundred thousand seabirds that nest on Kasatochi.

AVO's response to these eruptions included 24/7 monitoring; extended communications with individual mariners, pilots, and government agencies; the release of 84+ information products; and field crew visits to Okmok and Kasatochi. AVO's website, managed by DGGS, saw a four-fold increase in hits, and a similar increase in emails to the website. For more information on these eruptions, including photographs, please visit: http://www.avo.alaska.edu .

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CHIGINAGAK VOLCANO: VOLCANIC EVENT RESPONSE, GEOLOGIC MAPPING, AND HAZARD ASSESSMENT

Monitoring the persistent environmental damage from the 2005 acid crater lake drainage.

Mount Chiginagak is a hydrothermally active volcano on the Alaska Peninsula, approximately 170 kilometers (100 miles) south–southwest of King Salmon. Sometime between November 2004 and May 2005, a 400-meter-wide (~1,300-foot-wide), 100-meter-deep (~330-foot-deep) crater lake developed in the formerly snow- and-ice-filled crater of the volcano. In early May 2005, an estimated 3 million cubic meters (106 million cubic feet) of sulfurous, clay-rich debris and acidic water exited the crater through tunnels in the base of a glacier that breaches the south crater rim. More than 27 kilometers (17 miles) downstream, the acidic waters of the flood reached approximately 1.3 meters (4 feet) above current water levels and inundated an important salmon spawning drainage, acidifying Mother Goose Lake from surface to bottom (pH of 2.90 to 3.06) and preventing the annual salmon run in the King Salmon River. A release of caustic gas and acidic aerosols from the crater accompanied the mud-flow and flood, causing widespread vegetation damage along the flow path. A DGGS-led interdisciplinary science team has been monitoring the status of the remaining crater-lake water that continues to flow into Mother Goose Lake. Observations of the summit crater lake in August of 2008 indicate that over 1 million cubic meters (35 million cubic feet) of water remains in the crater and continues to supply acidic water to Mother Goose Lake and the King Salmon River. August 2008 pH measurements indicate a slight improvement in habitat conditions; however the water is far from hospitable. Anomalous high concentrations of iron (~25 mg/L) and aluminum (~18 mg/L) appear to be the most serious environmental threat in terms of metals. Hazardous metals such as arsenic, chromium, and copper are elevated well above normal levels. Based on the large volume of acidic water remaining in the crater lake, the likely continued contribution of acid water from the volcano's hydrothermal system, and the prolonged hydrolysis of iron and aluminum in the stream draining the crater and in Mother Goose Lake, improved water quality is not expected for at least several more years. In August of 2007, as part of a volcano-hazard assessment, the science team, in cooperation with Northern Arizona University lake core specialists, cored the bottom sediments of Mother Goose Lake with the goal of determining the recurrence interval for this type of acid flood from Chiginagak.

The lake core team sets anchors at Mother Goose Lake in preparation for bottom sediment sampling. Mount Chiginagak, the source of the 2005 acidic flood, looms in the background.

Geologic Mapping and Volcano Hazard Assessment

The DGGS-led geologic mapping and hazard assessment fieldwork that began in the Chiginagak volcano area in 2004 was completed in 2008. Investigations have revealed a long history of hydrothermal activity, debris avalanches, and lava flows at the volcano. A geologic map and volcano hazard assessment are scheduled to be published by DGGS in 2009. In addition to the FY08 publications listed below, peer-reviewed scientific journal articles are planned, with timing of publication dependent on the outcome of pending analytical results.

FY08 Publications

Schaefer, J. R., Scott, W.E., Evans, W.C., Jorgenson, J., McGimsey, R.G., and Wang, B., 2008, The 2005 catastrophic acid crater lake drainage, lahar, and acidic aerosol formation at Mount Chiginagak volcano, Alaska, USA: Field observations and preliminary water and vegetation chemistry results: Geochemistry Geophysics Geosystems, v. 9, n. 7, 29 p., Q07018, doi:10.1029/2007GC001900.

Schaefer, J.R., Wallace, K.L., and Kassel, C.M., 2008, Preliminary bathymetric map of Mother Goose Lake, Alaska Peninsula: Alaska Division of Geological & Geophysical Surveys Raw Data File 2008-3, 1 disc, available at http://www.dggs.dnr.state.ak.us/pubs/pubs?reqtype=citation&ID=16301 .

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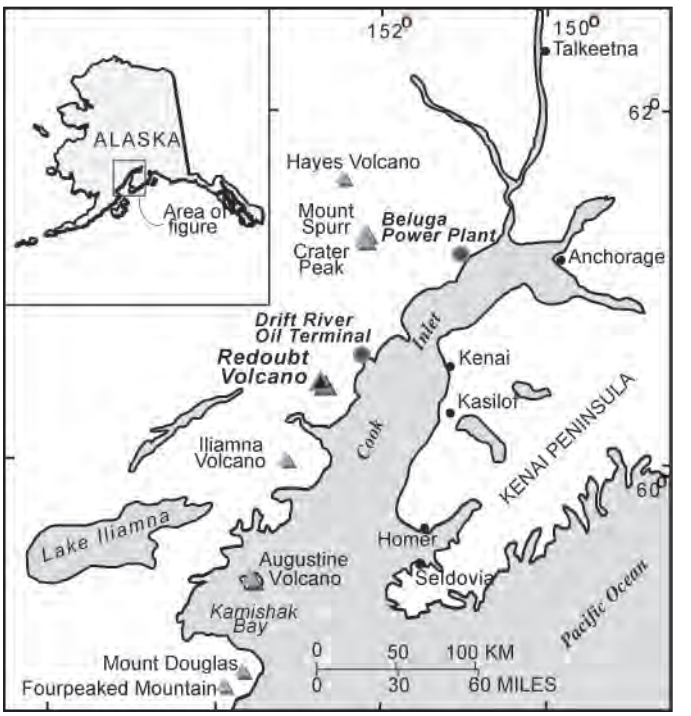
REDOUBT VOLCANO STUDIES

A long-term goal of the Alaska Volcano Observatory (AVO) is to produce an integrated Cook Inlet volcanoes risk assessment and hazard report, merging studies of the individual volcanoes. An initial step toward this goal is the completion of thorough single-volcano studies. This year we initiated efforts to produce an updated geologic history and hazard assessment of Redoubt Volcano, located 106 miles (170 km) southwest of Anchorage. The report is a collaboration between AVO geologists from DGGS, UAF and USGS, and will build on previous maps and hazard assessments. The most recent Redoubt eruption (1989-90) was the second costliest eruption in US history ($160 million in 1990 dollars). The eruption blanketed east-central Alaska with up to ¼ inch (5 mm) of ash; produced lahars (volcanic mudflows) that inundated the Drift River to Cook Inlet, partially flooding the Drift River Oil Terminal; and greatly damaged aircraft and disrupted air traffic during the winter holiday season.



Data Compilation and Field Work: We have compiled previous workers' geologic maps and hazard assessment reports—none of which were synoptic temporally and/or spatially—and made them available in GIS. We checked these compilations during fieldwork, and used them to determine areas that were under-studied or needed geologic clarification. The work comprised two weeks of helicopter-supported mapping and sampling of volcanic units for geochemistry and Ar-Ar and radiocarbon dating, as well as detailed proximal tephra studies and debris flow and lahar mapping in drainages on the north (Drift River), east (Redoubt Creek to Harriet Point) and south (Crescent River) sides of the edifice. We were based at the active Drift River Oil Terminal (DRT), located 22 miles (35 km) NE of Redoubt at the mouth of Drift River. While staying at DRT, we provided brief lectures to their staff describing the monitoring and research methods and goals of the AVO in general, and the purposes and applications of the Redoubt work in particular (DRT was flooded by lahars three times during the 1989–90 eruption of Redoubt).

Results So Far: Our mapping this season suggests that the previous work by Till et al. (1994) can be enhanced by further delineation of early pyroclastic deposits and by more thorough radiometric dating of the units. Re-investigation of early altered units on the east flank of the volcano at ~5,000 feet elevation suggests that they represent an eruption center that pre-dates the more recently active vents centered on the present summit (10,198 feet elevation). Detailed tephra investigations indicate a higher eruption frequency in the past than previously believed, and lahar studies confirm multiple episodes of Drift River valley inundation by lahars. A better understanding of the chronology of eruptions, the magma evolution and the nature of past eruptions will evolve once Ar/Ar and radiocarbon dates and geochemistry analyses are received.

Future Work: We will digitize 2008 map modifications; make petrographic analyses of geochemistry and dating samples; compile analytical results; and interpret those results as a guide for 2009 field work.

Products: An updated geologic map and hazard assessment of Redoubt Volcano will be published through DGGS within the next five years, and will be incorporated into the Integrated Cook Inlet Volcanoes Hazard Assessment Report. Additional data will be made available as DGGS Raw Data Files.

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ALASKA VOLCANO OBSERVATORY WEBSITE

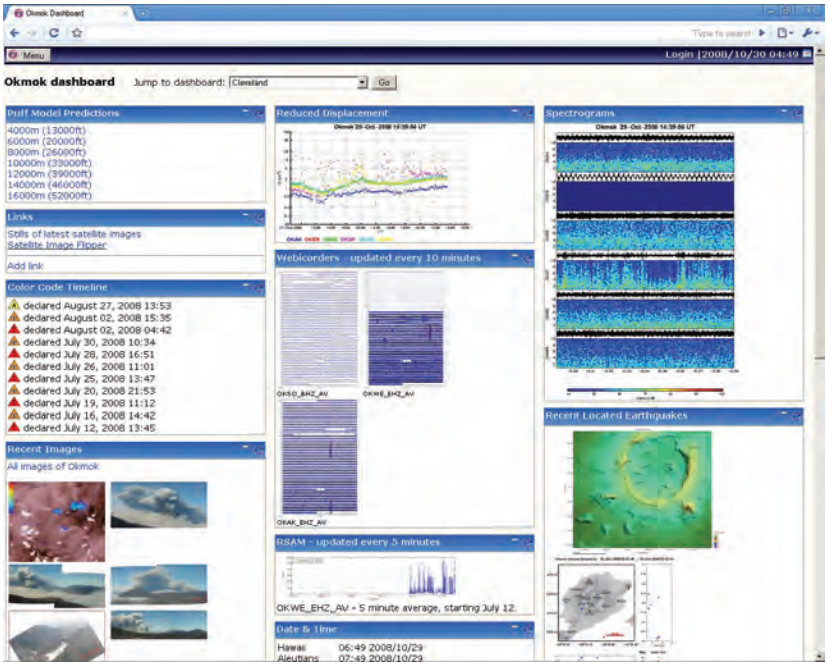
The AVO public website (http://www.avo.alaska.edu) serves about 1,500,000 pages and approximately 300 gigabytes of data to well over 100,000 unique visitors per month, and is among the top ten USGS and USGS-affiliated web sites in the country. It continues to be the most complete single resource on Quaternary volcanism in Alaska. DGGS was the original creator of the AVO website in 1994, and continues to be the site designer, builder, and manager.

During FY08, DGGS put a large emphasis on implementing the Hazard Notification System, or HANS. HANS requirements were defined by a nationwide committee of the Consortium of U.S. Volcano Observatories—our job was to implement those requirements in a web-accessible database format. This system serves as the central point for storing volcano activity information and parsing that information into formats specifically tailored to the requirements of different users, such as the Federal Aviation Administration (FAA). A separate instance of HANS has been installed on a USGS server to release information for the Mariana Islands volcanoes. All other U.S. volcano observatories are moving to adopt HANS as the standard system for creating and releasing volcano information.

HANS synchronizes data between instances, thus allowing AVO to maintain a backup up of information released by the other U.S. observatories, as well as allowing AVO releases to be backed up on other observatory's servers. This synchronization will allow AVO to release information even if its own servers are unreachable due to system errors or network problems.

The AVO internal website displays complex near-real-time seismological and satellite data over the web for observatory staff, making distributed monitoring possible. The internal website is also becoming a central location for managing images, sample, and geochemical data, as well as organization-wide information. This information is stored in the database, where it is easily searched and exported in a variety of useful formats.

A rapidly evolving section of the internal website is the volcano "dashboard" pages (see figure). Each currently active volcano has its own page of combined monitoring data. These pages allow users to visit a single location containing snapshots of current data, with links to more detailed data and information. These dashboards were heavily used during the 2008 summer eruptions of Okmok, Kasatochi, and Cleveland volcanoes.



Okmok volcano "Dashboard" web page brings together data from different monitoring methods in one centralized location, giving users a quick glimpse into activity at the volcano.

AVO is on the leading edge of web development for volcano observatories, and is actively sharing its expertise with other observatories in the U.S. DGGS is following new and emerging technologies that will allow us to further enhance AVO's web presence and data dissemination abilities. DGGS continually refines and enhances the applications that AVO and other observatories use on a regular basis. We will focus on continual incremental improvements to the site, and serving new database modules as they become available.

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ALASKA VOLCANO OBSERVATORY: GEODIVA DATABASE

DGGS Volcanology section staff design, populate, and distribute the Geologic Database of Information on Volcanoes in Alaska (GeoDIVA) for the Alaska Volcano Observatory (AVO). The mission of GeoDIVA is to maintain complete, flexible, timely, and accurate geologic and geographic information on Pleistocene and younger Alaska volcanoes (those that have erupted in approximately in the past 2 million years) for scientific investigation, crisis response, and public information in a dynamic, digital format. This information system is the most comprehensive, accurate, and up-to-date source of information on Alaska volcanoes available anywhere, online or in printed form. GeoDIVA is being developed in modules. Each module is released as it is finished to streamline the delivery of information to the public. The AVO website (www.avo.alaska.edu, also a DGGS effort, described separately), is the primary means of information dissemination.

Module	Status	Notes
Bibliography	Complete through 2007	Updated yearly to include new publications—fully searchable, currently 4,200+ references.
Basic volcano information	Complete – but see Vent Count module	~140 major and ~200 minor volcanic features in Alaska: 52 historically active volcanoes (using newly refined definition)
Eruption history information	Complete through mid 2008	Information, actual text, and references for more than 400 historic eruptions. Also created a location to show non-eruptive events, and classified them.
Images	Structure complete—data loading in progress	Currently contains almost 14,000 pictures, figures, and maps. Images from previous years, as well as current photographs are being added; captions and other metadata continually refined.
Sample information	Structure complete—data loading in progress	Currently contains information for ~4,000 samples. Published sample information, as well as newly-collected samples are being added.
Geochemistry	Structure complete—data loading in progress	Geochemistry data loaded for more than 1,500 analyses (~60,000 records). Currently adding analyses from published sources and current fieldwork.
Petrology	Structure complete—data generation and loading in progress	Planned arc-wide thin section images and descriptions. ~50 Augustine thin sections with 1,000 point counts complete.
Hand sample storage	Structure complete – data loading in progress	Fairbanks sample storage archiving is caught up to present-day samples. Yearly maintenance is required.
FieldDIVA	Beta phase	Mini-GeoDIVA for field use. (No field work done in summer 2007;

Our current in-development modules are:

- Geospatial: to archive and distribute AVO's geospatial data, including geologic maps, topographic bases, satellite data, and other georeferenced vector and raster data. In 2008 we completed construction of tables to hold geospatial metadata, and continued research and testing of software solutions, as well as communicating with other volcano geospatial database groups about their solutions and system interoperability. This module has several planned steps: (1) internal organization, inventory, upload, storage, and retrieval of AVO GIS data; (2) dissemination of the data via the web – first to internal users and then to the public; (3) eventually, develop geospatial query capability (map interface) to both our internal and our public websites.
- Geochemistry: Although the table structure has been in place for several years, and data loading and retrieval are on-going, during 2008 we made several refinements, including (1) restructuring the table design so it is simpler to use and interfaces more easily with a wider variety of other geospatial efforts; and (2) upgrading our internal web interface for geochemistry.
- Geochronology: Table structure is nearly complete; still communicating with geochronologists about their needs and wish-lists. We have collected a large library of specific references containing age dates for Alaskan volcanic rocks in anticipation of data loading.
- Vent Inventory (described separately): collecting, classifying, and displaying Alaska's Quaternary volcanic vents to produce a referred, consistent list of vents. This has not previously been done, and is intended to aid investigations into spatio-temporal variations which may have genetic implications, as well as provide a firm basis for enumerating volcanoes.

This project is funded by cooperative agreements with the USGS that support DGGS's participation in AVO. GeoDIVA grows by continual feeding of new data to existing modules and episodic surges of growth as new modules come on line. See the accompanying table for completed, in progress, and planned modules of GeoDIVA.

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COUNTING VOLCANOES
INVENTORY OF ALASKA VOLCANOES

The Alaska Volcano Observatory is developing an updated, refereed, consistent list of vents, volcanic centers, and historically active volcanoes. Previously published lists of Alaska volcanoes are often fundamentally different from each other in what they seek to describe; sometimes possess internal inconsistencies; and do not include recent activity and recently recognized volcanoes. The DGGS-developed Geologic Database of Information on Volcanoes in Alaska (GeoDIVA) is a uniquely thorough resource that can be used to count, categorize, and qualify volcanic features and events using explicit standardized criteria. Using traditional groupings of separate and dependent volcanoes, defining the term "eruption" to include both magmatic and phreatic eruptions, and further including suspected eruptions, persistent summit fumaroles, measured volcanic deformation, and volcanogenic earthquake swarms as evidence of activity, we can refine the volcano count.

Alaska has:

- about 140 Quaternary volcanoes,
- 94 of which had Holocene activity,
- 52 of which have been historically active (1700 CE to present), and
- 28 of which have had historical magmatic eruptions.

These numbers are as much as 20 percent higher than similar numbers from existing published lists.

One continuing question with our "new" list is its reliance on our traditional grouping hierarchy, which isn't dependent on any explicit criteria. This makes it difficult to determine why some close-together volcanoes have been traditionally classified as separate (e.g. stratocones Martin and Mageik) and why others are lumped as one volcanic center (e.g. the dozen or so stratocones on Semisopochnoi Island). Having a list of all vents, their descriptions, and their locations will help in determining better, more rigid hierarchies. Detailed studies are now available for many centers, but there's been no broad effort to locate and classify every known Quaternary vent since the Luedke and Smith 1:2,000,000 scale map was published in 1986.

In the interest of enlarging our knowledge about Alaskan volcanism, and toward creating criteria and rules for a hierarchical classification of Alaskan vents, we have begun re-compiling vent information. So far, there are more than 1,200 identified vents (in contrast to the ~140 centers and ~250 subfeatures previously included in GeoDIVA.) We recognize that some centers have more detailed knowledge than others, and anticipate that this list will grow and change as our mapping improves and expands. We plan to have the initial, basic information entered and available by the end of the 2009 calendar year.

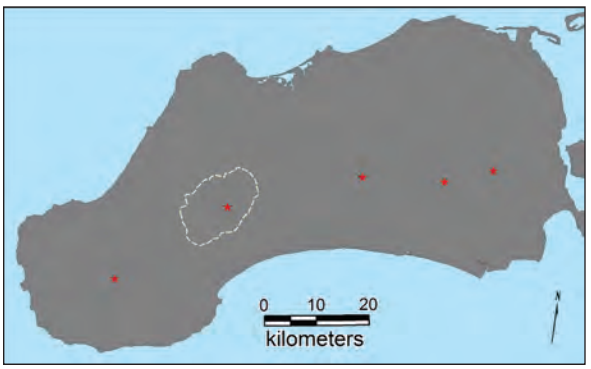

Figure 1. Traditional map of Alaskan volcanoes on Unimak Island.

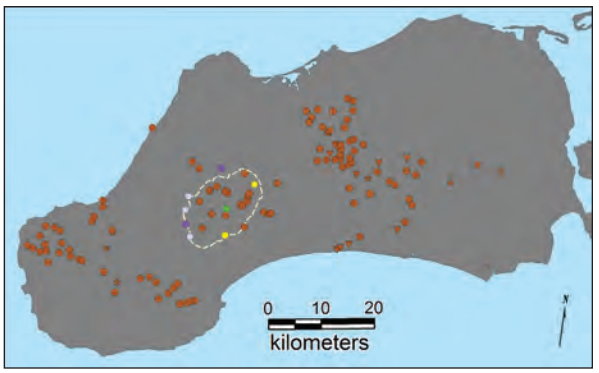

Figure 2. Map of all known Quaternary Alaskan volcanic vents on Unimak Island.

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DIGITAL GEOLOGIC DATABASE PROJECT

In 2000, the Alaska Division of Geological & Geophysical Surveys (DGGS) initiated development of a geologic database system that provides the architecture for consistent data input and organization. The database system includes data identification and retrieval functions that guide and encourage users to access geologic data online. This project was initially part of the federally funded Minerals Data and Information Rescue in Alaska (MDIRA) program; ongoing data input, use, and maintenance of the database system are now part of DGGS's normal operations supported by general funds.

The Digital Geologic Database Project has three primary objectives. The first established a spatially referenced geologic database system in a secure, centralized information architecture with networked data access for new and legacy DGGS geologic data. The second objective created a functional online 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 integrated DGGS's minerals-related data with data from other agencies through the MDIRA website http://akgeology.info.

During the first seven years, the project work group identified geologic data for inclusion in the database, established a secure and stable database structure, and started loading data into the database. As a result, the public can access DGGS and USGS reports and maps, and DGGS project digital data through a search page on the DGGS website http://www.dggs.dnr.state.ak.us/pubs and access DGGS geochemical data though a search engine http://www.dggs.dnr.state.ak.us/webgeochem. Users can search for DGGS reports and maps, along with geology and minerals reports from other agencies, through an integrated bibliography on the AKGeology.info website http://bib.akgeology.info.

During 2009, the project team will be supporting ongoing DGGS MDIRA projects by extending the DGGS database, and designing web-based search engines for the Alaska Geologic Map Index, Geochronologic Database for Alaska, and Geologic Materials Center Database projects. The team will also load geochronological and geochemical data, legacy data and map archive index, and geologic map index information into the database, and will work to integrate DGGS data with other datasets on the MDIRA website http://akgeology.info.

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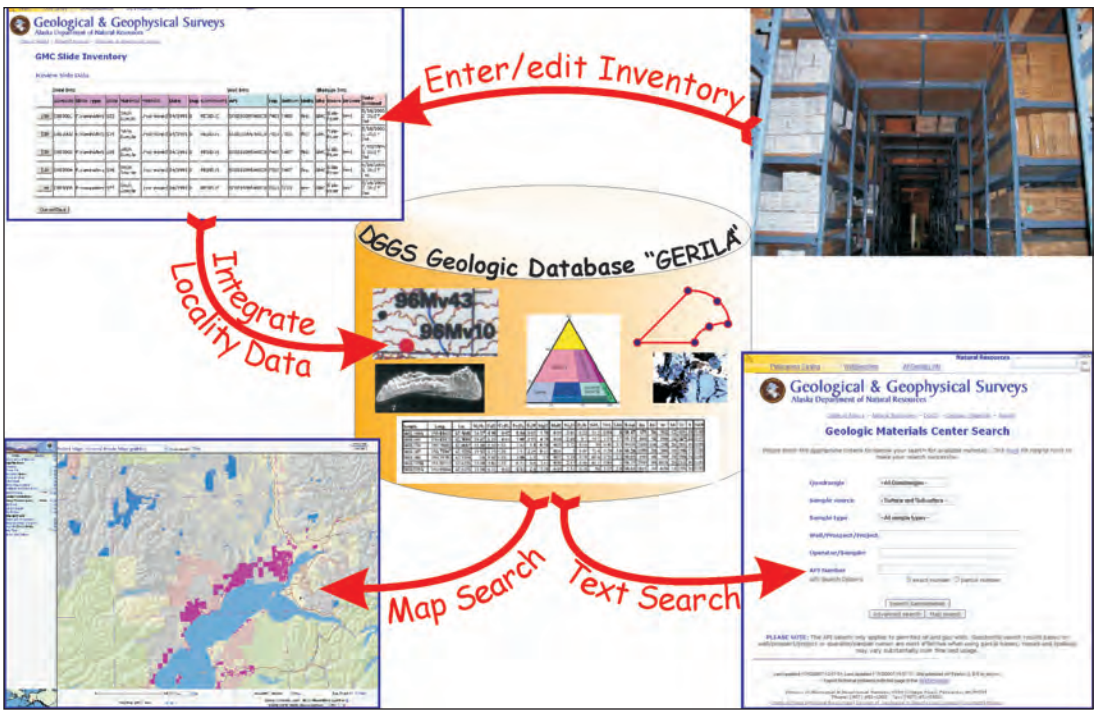
GEOLOGIC MATERIALS CENTER ONLINE SAMPLE CATALOG

The Alaska Geologic Materials Center (GMC) is the central repository in which geologic samples collected throughout Alaska are cataloged, stored, and studied. This archive facility holds geologic sample materials from a multitude of sources including government agencies, mineral companies, and oil and gas companies. For more details on the holdings at the GMC, please see the web page http://www.dggs.dnr.state.ak.us/?link=gmc_overview&menu_link=gmc. As part of the federally funded Minerals Data and Information Rescue in Alaska (MDIRA) project, DGGS is overseeing the development of a new rock sample and hard rock drill core inventory system for the materials housed at the GMC in Eagle River.

The ultimate goal of the GMC on-line catalog component is to provide a secure, reliable catalog of the geologic materials held by the GMC and to provide public users with tools for searching for samples of interest and to assess their availability and condition prior to traveling to the GMC. The focus of the project is to provide a framework for a single digital index and catalog of DGGS and mineral industry cores and samples. While accomplishing that direct MDIRA goal, the project will integrate and upgrade the existing in-house digital catalog of oil and gas industry samples and the catalog of U.S. Bureau of Mines and U.S. Bureau of Land Management mineral and coal samples into the same database and online search engine.

Application development is underway in cooperation with Land Records Information Section (LRIS) under the direction of DGGS database project staff. The project has two immediate objectives. The first objective is to construct functional bulk data-loading and reporting tools that allow GMC staff to load and view data in a centralized, secure database environment. The second objective involves integrating the tools, reports, and data into the DGGS relational database. The application and database design allows for future extension of the application to achieve the third objective of a sample tracking and inventory control system.

Integration of the GMC catalog with the DGGS relational database will provide a direct connection between sample locality descriptions, DGGS analytical data, DGGS publications, and archived sample materials. Final production deployment of the application and data, expected at the end of 2009, will provide both web-based geographic and simple text searches for all the physical sample holdings of the GMC. The search results will include documentation of locality information, and provide condition of the archived materials and detailed analytical information where available.



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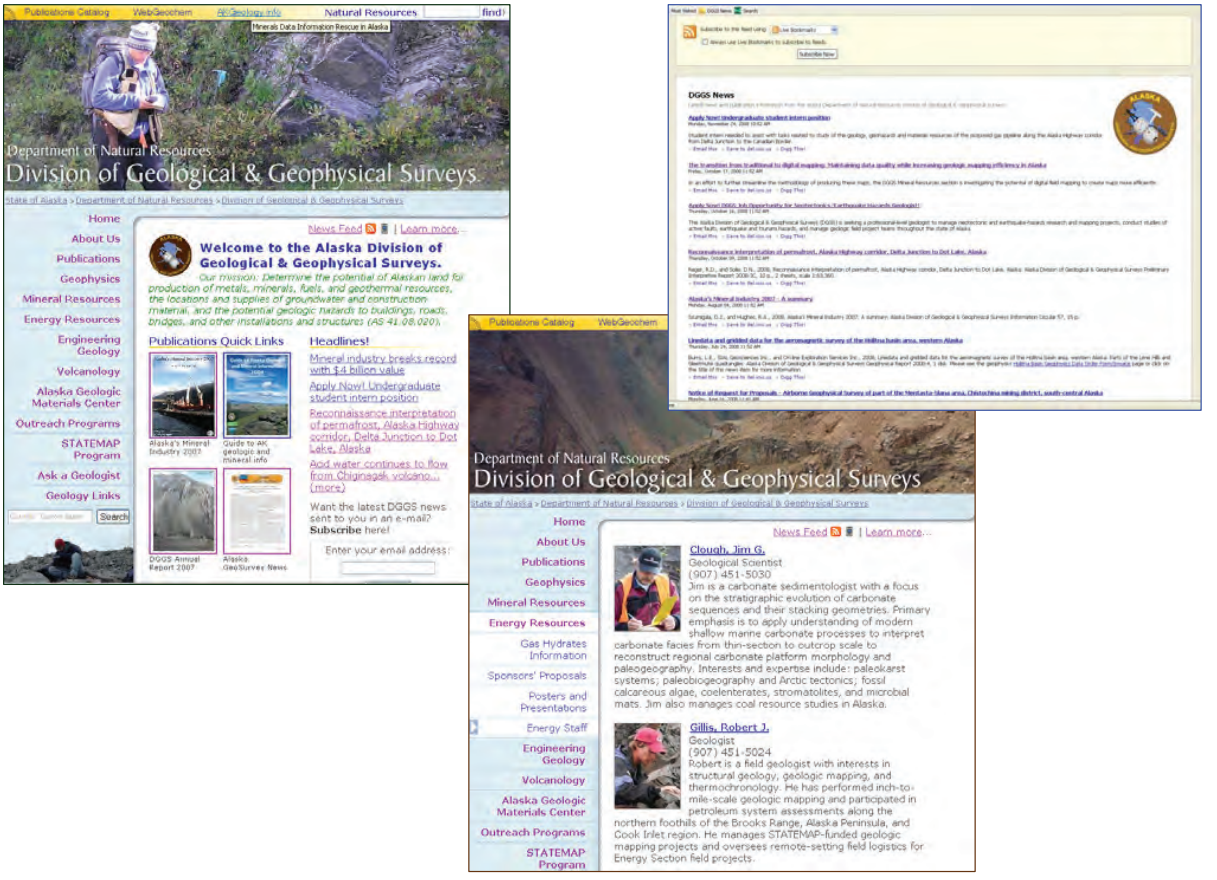
DGGS WEBSITE

Since its creation in the late 1990s the DGGS website has grown from a few static HTML pages to the division's primary mechanism for distribution of geologic publications and information. As the cumulative result of a series of multi-year projects, our current website allows our online customers to: search our publications catalog, download DGGS and USGS publications, view and download DGGS geochemical data, and find current information about various geologic projects and topics of interest. Public users can currently select and download (at no charge) more than 7,000 text reports, 9,000 oversize sheets, and a growing assortment of GIS datasets.

In 2007, DGGS implemented a significant code and design renovation to the DGGS website. The outdated HTML pages were replaced by PHP files. The PHP format allowed us to replace our tabular menu structure with a dynamic, context-sensitive navigation menu. User response to the new site design has been highly positive and, as a result, we have continued to expand upon the design and populate the site content.

The PHP format has streamlined the process of adding information to the website and created opportunities for design staff to work on building new features and behind-the-scenes development of future website content and applications. New features that were added in 2008 include photos and brief bios of research geologists, a listing of current projects organized by section, and an RSS feed. The RSS feed provides up-to-the-minute news and updates to subscribers. Items in development include a web-based application that will allow DGGS users to search our archived field data collections (notebooks, field maps, etc.), a web-accessible interface to our geochronology database, and a web-accessible interface to the Geologic Materials Center catalog.



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PUBLICATIONS AND OUTREACH PROJECT

The Publications Project staff publishes and distributes the geologic data collected, analyzed, and assembled by geologists 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 carry out are:

- Perform design, layout, and editing, and oversee final production of technical and educational geologic maps and reports in printed and digital formats.
- Produce an annual report for the Legislature and public, required by statute and written by division staff, summarizing DGGS activities and products and communicating plans for its future projects.
- Publish two annual newsletter issues that communicate DGGS progress and announce the latest publications.
- Prepare displays and represent the division at geologic conferences and meetings by providing staff and assembling and transporting the display booth.
- Staff DGGS's information desk in Fairbanks, providing information in response to numerous inquiries about Alaska's geologic resources and hazards.
- Manage sales and distribution of DGGS's printed and online geologic reports, maps, and digital data.
- Review metadata for each project; file it in the appropriate digital repository. Assist other staff members as they prepare metadata for spatial data they will distribute.
- Manage the DGGS reference library so that reports, maps, and other data are available and information is on hand that staff need for research when preparing geologic products.
- Maintain a complete collection of Alaska-related publications produced by the U.S. Geological Survey, the former U.S. Bureau of Mines, and the U.S. Bureau of Land Management; collect and maintain other Alaska-related publications as needed.
- Participate in school outreach activities such as helping prepare classroom presentations, judging science fair entries, or helping teachers by presenting earth science units.

The publications produced and distributed 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 geologic maps for specific areas in the state; sources of Alaska's geologic information; annual information about DGGS's programs and accomplishments; airborne 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 *Alaska's Mineral Industry 2007;* two newsletters, the first highlighting the Alaska Volcano Observatory and the second explaining the use of digital mapping techniques in DGGS projects; a large volume summarizing preliminary results of recent field investigations in the Brooks Range foothills and North Slope; a reconnaissance interpretation of permafrost for the Alaska Highway corridor, from Delta Junction to Dot Lake; and a preliminary bathymetric map of Mother Goose Lake on the Alaska Peninsula.

Publications are available in paper format (plotted as needed and sold for the cost of printing) and as PDF documents and scanned compressed maps on the DGGS web page (available for free download). An increasing number of digital datasets are available on the publications pages as additional products. Work continues in FY2009 to increase the availability of digital datasets from which GIS maps are produced, so that customers can manipulate data as they choose; and publishing documents in digital format first, then using the digital publication to produce a paper copy when necessary. The geological and geophysical data and reports published by DGGS encourage wise management and exploration of Alaska's natural resources and mitigation of risks from the state's geologic hazards.

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NATIONAL GEOLOGICAL AND GEOPHYSICAL DATA PRESERVATION PROGRAM

The Alaska Division of Geological & Geophysical Surveys (DGGS) has, as its statutory mission, the responsibility for collecting, archiving, managing, and disseminating geological and geophysical data on the subsurface energy resources, mineral resources, and geologic hazards of the state. During the last 10 years, through the federally funded Minerals Data and Information Rescue in Alaska (MDIRA) program, DGGS has greatly improved and cataloged the condition of its geological and geophysical data archive, upgraded its data management system, and has begun disseminating this data through the internet. These improvements are especially pronounced for general geologic information and mineral resources data, but are lagging with respect to energy resource and geologic hazard data sets.

During FY2008, as part of the federally funded National Geological and Geophysical Data Preservation (NGGDP) program, DGGS conducted an assessment of data preservation needs, including an evaluation of progress, data holdings, and gaps remaining from the MDIRA program. We developed a customized questionnaire for division geologists to provide detailed information about the current DGGS collections related to geological, geophysical, and engineering data, maps, well logs, and samples, and to summarize the data preservation needs for those collections. The responses to these questionnaires were reported to the U.S. Geological Survey (USGS) by completing their on-line Inventory of Geological and Geophysical Collections form, and collating the information in a final technical report. The resulting report lists the volume of 12 datasets, current data formats, confidentiality versus proprietary ownership, design and capacity of the storage system for holding existing and future data, and current public access and use.

The next phase of NGGDP program requires DGGS to provide to the National Data Catalog digital metadata for selected site-specific data collections. Access to these data collections will improve their accessibility to both in-state and national users. Datasets for which DGGS will submit catalog metadata are: (1) core samples and drill cuttings stored at the Alaska Geologic Materials Center (GMC), (2) glass slide collection of processed samples at the GMC, (3) data reports on core samples that have been borrowed from the GMC for analysis, (4) hard-rock surface samples collected by DGGS staff, (5) geochemical analyses of rock, soil and stream sediment samples collected during projects involving DGGS geologists, and (6) geochronology analyses of samples collected during projects involving DGGS geologists.

This project is funded by USGS, as part of the National Geological and Geophysical Data Preservation Program, authorized by the National Energy Policy Act of 2005. For more information on this program, please go to the web page, http://datapreservation.usgs.gov.

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GIS–IT INFRASTRUCTURE PROJECT

The DGGS IT staff conducts projects that provide improved computer services to employees and streamlined Web access for external users. DGGS has made major improvements to the network in 2008 to improve that service. We continue to utilize LANdesk for automated asset tracking and management as well as the remote installation of software packages and updates. Employing LANdesk's ability for remote desktop administration and control has greatly reduced both response time and productivity.

The desktop backup project was finalized with the installation on every desktop machine of a scheduled task that makes a full backup. This protection practically eliminates the risk of data loss due to file corruption or deletion. We currently have 14 terabytes of disk space allocated to backing up desktop systems.

All servers, both Windows and UNIX based, were migrated to a disk-based backup system, reducing the time required for the restoration of files from hours to minutes.

As part of the statewide Voice over Internet Protocol (VoIP) migration, the connection to the State of Alaska WAN was migrated from older, copper-wire-based connection to redundant fiber optic link. This also increased our bandwidth into and out of our local network to a 10 megabyte connection, providing both more reliability and bandwidth for the general public downloading data from the DGGS website, as well as increasing bandwidth to the desktop users in the Fairbanks office.

As an additional part of the VoIP migration, we installed an enterprise level single chassis switch, increasing the backplane bandwidth to full dedicated gigabit.

As our programmers develop more complex code with interdependencies that rely on other state-generated code, we added a version tracking program, allowing seamless access to prior versions of code for troubleshooting and bug fixes.

The primary fileserver for staff use was upgraded from an older Sun machine to a new Dell PE2950 with 6 terabytes of internal storage. This change in hardware also allowed us to migrate to a new operating system (Redhat v5.2), greatly reducing costs required for maintenance agreements.

Since the installation of a Mitsubishi uninterruptible power supply (UPS), we have experienced an electrical uptime of 100%. For 2007, we had 35 minutes of unscheduled downtime, resulting in a 99.994% uptime.

Technology upgrades at the Geologic Materials Center included the installation of a wireless link between two buildings, installation of a local 100mb switch, and two new computers to replace failing equipment.

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ALASKA 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 on Federal, State, and private lands of Alaska, including the Alaska outer continental shelf. Of this collection, a little over 228,000 feet are diamond-drilled hard-rock mineral core. The GMC collection includes rock materials from more than 1,400 oil and gas exploratory or production wells, rock core from nearly 1,100 exploratory hard-rock mineral holes, samples for some geotechnical test wells, and numerous surface rock samples. The collection also includes extensive geochemical data, petrographic thin sections, and paleontological glass slides derived from this rock.

The GMC is operated by the Alaska Department of Natural Resources, Division of Geological & Geophysical Surveys, with support from cooperating government agencies that include 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 mission of the GMC is to archive all worthwhile rock samples collected in Alaska and on the Alaska outer continental shelf. The chief users of the GMC are the oil and gas industry, although use by the minerals industry, government, engineering firms, and academic institutions is increasing.

As of the first of November 2008, the GMC had 185 visitations with another 623 contacts (by phone, mail, or e-mail) during FY09. To date in FY09, the GMC has also received 252 processed oil-gas petrographic, microfossil, or geochemical glass slides and three technical data reports.

In FY08, there were 497 total visitations and another 2,386 contacts with the facility. The GMC also received a total of 1,343 processed slides and 12 technical data reports.

Also as of early November 2008, the GMC has received 54 pallets of rock samples in FY09, representing the following:

- Calista Corporation Nyac gold property; 11 pallets of rock reject and pulp from core and shallow soil samples.
- Anadarko Petroleum Corporation Hot Ice No. 1; 8 pallets of continuous originally frozen core received through the University of Alaska Fairbanks and ASRC for the Alaska Oil & Gas Conservation Commission.
- U.S. Government Amchitka Island test holes; 22 pallets of core received through University of Alaska Fairbanks.
- Bristol Bay Native Corporation Kemuk iron-titanium-platinum prospect; 6 pallets representing 8,338 feet of core from 14 holes.
- U.S. Geological Survey (U.S. Dept. of Interior) Franklin Bluff No. 1 coal-bed methane hole; 2 pallets received for Alaska Oil & Gas Conservation Commission representing 1,325 feet of core and cuttings.
- U.S. Geological Survey Wainwright No. 1 coal-bed methane hole; 4 pallets received for Alaska Oil &Gas Conservation Commission representing 1,530 feet of continuous core.
- Seven addition “released” oil and gas wells from the Alaska Oil & Gas Conservation Commission.

Because the volume of samples has far exceeded its warehouse capacity, the GMC now has a total of 60 portable metal CONNEX container, 50 of which are occupied with samples. For FY09, three CONNEX containers have been added; one donated by the Calista Corporation and the other two donated by the U.S. BLM. The BLM has also donated the shelving for all three CONNEX containers. Twelve additional pallets of surface rock samples are presently anticipated from DGGS geologists in FY09, as is the donation of the Micropaleo processed microfossil collection and corresponding sample residues.

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PUBLICATIONS RELEASED IN 2008

ANNUAL REPORTS

AR 2007. Alaska Division of Geological & Geophysical Surveys Annual Report, by DGGS Staff, 2008, 69 p. Free.

GEOPHYSICAL MAPS & REPORTS

GPR 2006-8. Final processed database for the airborne geophysical surveys of the Alaska Highway corridor, east-central Alaska, by Burns, L.E., Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2008, 1 disk. 1 DVD $15.

GPR 2008-1. Line, grid, and vector data, plot files, and descriptive project report for the airborne geophysical survey of part of the western Fortymile mining district, east-central Alaska, by Burns, L.E., U.S. Bureau of Land Management, Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2008, 9 sheets, 1 disk. 1 DVD $15.

GPR 2008-1-1A. Total magnetic field of part of the western Fortymile mining district, east-central Alaska, by Burns, L.E., U.S. Bureau of Land Management, Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2008, 1 sheet, scale 1:63,360. Topography included. $13.

GPR 2008-1-1B. Total magnetic field of part of the western Fortymile mining district, east-central Alaska, by Burns, L.E., U.S. Bureau of Land Management, Stevens Exploration Management Corp., and Fugro Airborne Surveys Corp., 2008, 1 sheet, scale 1:63,360. Magnetic data contours included. $13.

GPR 2008-1-1C. First vertical derivative of the total magnetic field of part of the western Fortymile mining district, east-central Alaska, by Burns, L.E., U.S. Bureau of Land Management, Stevens Exploration Management Corp., and Fugro Airborne Surveys Corp., 2008, 1 sheet, scale 1:63,360. $13.

GPR 2008-1-2A. 56,000 Hz coplanar apparent resistivity of part of the western Fortymile mining district, east-central Alaska, by Burns, L.E., U.S. Bureau of Land Management, Stevens Exploration Management Corp., and Fugro Airborne Surveys Corp., 2008, 1 sheet, scale 1:63,360. Topography included. $13.

GPR 2008-1-2B. 56,000 Hz coplanar apparent resistivity of part of the western Fortymile mining district, east-central Alaska, by Burns, L.E., U.S. Bureau of Land Management, Stevens Exploration Management Corp., and Fugro Airborne Surveys Corp., 2008, 1 sheet, scale 1:63,360. 56,000 Hz resistivity data contours included. $13.

GPR 2008-1-3A. 7200 Hz coplanar apparent resistivity of part of the western Fortymile mining district, east-central Alaska, by Burns, L.E., U.S. Bureau of Land Management, Stevens Exploration Management Corp., and Fugro Airborne Surveys Corp., 2008, 1 sheet, scale 1:63,360. Topography included. $13.

GPR 2008-1-3B. 7200 Hz coplanar apparent resistivity of part of the western Fortymile mining district, east-central Alaska;, by Burns, L.E., U.S. Bureau of Land Management, Stevens Exploration Management Corp., and Fugro Airborne Surveys Corp., 2008, 1 sheet, scale 1:63,360. 7200 Hz resistivity data contours included. $13.

GPR 2008-1-4A. 900 Hz coplanar apparent resistivity of part of the western Fortymile mining district, east-central Alaska, by Burns, L.E., U.S. Bureau of Land Management, Stevens Exploration Management Corp., and Fugro Airborne Surveys Corp., 2008, 1 sheet, scale 1:63,360. Topography included. $13.

GPR 2008-1-4B. 900 Hz coplanar apparent resistivity of part of the western Fortymile mining district, east-central Alaska, by Burns, L.E., U.S. Bureau of Land Management, Stevens Exploration Management Corp., and Fugro Airborne Surveys Corp., 2008, 1 sheet, scale 1:63,360. 900 Hz resistivity data contours included. $13.

GPR 2008-2. Preliminary final version of part of the airborne geophysical data from the Styx River Survey, southcentral Alaska: parts of Lime Hills and Tyonek quadrangles, by Burns, L.E., Fugro Airborne Surveys Corp., Stevens Exploration Management Corp., and Anglo American Exploration (USA), Inc., 2008, 5 sheets, scale 1:63,360, 1 CD. CD contains geophysical data produced from airborne surveys conducted in 2007 for the eastern part of the Styx River survey area, southcentral Alaska. The data have been processed to the final stage; however, when the data are merged with data for the remaining area, minor changes to these maps and data might be necessary. The remaining survey area data will be acquired, processed, merged with this data, and released as GPR 2008-3. $10.

GPR 2008-3. Line, grid, and vector data, and plot files for the airborne geophysical survey of the Styx River Survey, southcentral Alaska, by Burns, L.E., Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2008, 27 sheets, 1 disk. 1 DVD. Supersedes GPR 2008-2. Download the digital data free of charge. DVD $15.

GPR 2008-3-1A. Total magnetic field of the western Styx River Survey, southcentral Alaska, by Burns, L.E., Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2008, 1 sheet, scale 1:63,360. Topography included. $13.

GPR 2008-3-1B. Total magnetic field of the southern Styx River Survey, southcentral Alaska, by Burns, L.E., Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2008, 1 sheet, scale 1:63,360. Topography included. $13.

GPR 2008-3-1C. Total magnetic field of the eastern Styx River Survey, southcentral Alaska, by Burns, L.E., Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2008, 1 sheet, scale 1:63,360. Topography included. $13.

GPR 2008-3-2A. Total magnetic field of the western Styx River Survey, southcentral Alaska, by Burns, L.E., 2008, 1 sheet, scale 1:63,360. Magnetic contours included. $13.

GPR 2008-3-2B. Total magnetic field of the southern Styx River Survey, southcentral Alaska, by Burns, L.E., Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2008, 1 sheet, scale 1:63,360. Magnetic countours included. $13.

GPR 2008-3-2C. Total magnetic field of the eastern Styx River Survey, southcentral Alaska, by Burns, L.E., Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2008, 1 sheet, scale 1:63,360. Magnetic contours included. $13.

GPR 2008-3-3A. First vertical derivative of the total magnetic field of the western Styx River Survey, southcentral Alaska, by Burns, L.E., 2008, 1 sheet, scale 1:63,360. Topography included. $13.

GPR 2008-3-3B. First vertical derivative of the total magnetic field of the southern Styx River Survey, southcentral Alaska, by Burns, L.E., Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2008, 1 sheet, scale 1:63,360. Topography included. $13.

GPR 2008-3-3C. First vertical derivative of the total magnetic field of the eastern Styx River Survey, southcentral Alaska, by Burns, L.E., Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2008, 1 sheet, scale 1:63,360. Topography included. $13.

GPR 2008-3-4A. 56,000 Hz coplanar apparent resistivity of the western Styx River Survey, southcentral Alaska, by Burns, L.E., Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2008, 1 sheet, scale 1:63,360. Topography included. $13.

GPR 2008-3-4B. 56,000 Hz coplanar apparent resistivity of the southern Styx River Survey, southcentral Alaska, by Burns, L.E., Fugro Airborne Surveys Corp., and Stevens Exploration Inc., 2008, 1 sheet, scale 1:63,360. Topography included. $13.

GPR 2008-3-4C. 56,000 Hz coplanar apparent resistivity of theeastern Styx River Survey, southcentral Alaska, by Burns, L.E., Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2008, 1 sheet, scale 1:63,360. Topography included. $13.

GPR 2008-3-5A. 56,000 Hz coplanar apparent resistivity of the western Styx River Survey, southcentral Alaska, by Burns, L.E., Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2008, 1 sheet, scale 1:63,360. Resistivity contours included. $13.

GPR 2008-3-5B. 56,000 Hz coplanar apparent resistivity of the southern Styx River Survey, southcentral Alaska, by Burns, L.E., Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2008, 1 sheet, scale 1:63,360. Resistivity contours included. $13.

GPR 2008-3-5C. 56,000 Hz coplanar apparent resistivity of the eastern Styx River Survey, southcentral Alaska, by Burns, L.E., Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2008, 1 sheet, scale 1:63,360. Resistivity contours included. $13.

GPR 2008-3-6A. 7200 Hz coplanar apparent resistivity of the western Styx River Survey, southcentral Alaska, by Burns, L.E., Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2008, 1 sheet, scale 1:63,360. Topography included. $13.

GPR 2008-3-6B. 7200 Hz coplanar apparent resistivity of the southern Styx River Survey, southcentral Alaska, by Burns, L.E., Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2008, 1 sheet, scale 1:63,360. Topography included. $13.

GPR 2008-3-6C. 7200 Hz coplanar apparent resistivity of the eastern Styx River Survey, southcentral Alaska, by Burns, L.E., Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2008, 1 sheet, scale 1:63,360. Topography included. $13.

GPR 2008-3-7A. 7200 Hz coplanar apparent resistivity of the western Styx River Survey, southcentral Alaska, by Burns, L.E., Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2008, 1 sheet, scale 1:63,360. Resistivity contours included. $13.

GPR 2008-3-7B. 7200 Hz coplanar apparent resistivity of the southern Styx River Survey, southcentral Alaska, by Burns, L.E., Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2008, 1 sheet, scale 1:63,360. Resistivity contours included. $13.

GPR 2008-3-7C. 7200 Hz coplanar apparent resistivity of the eastern Styx River Survey, southcentral

Alaska, by Burns, L.E., Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2008, 1 sheet, scale 1:63,360. Resistivity contours included. $13.

GPR 2008-3-8A. 900 Hz coplanar apparent resistivity of the western Styx River Survey, southcentral Alaska, by Burns, L.E., Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2008, 1 sheet, scale 1:63,360. Topography included. $13.

GPR 2008-3-8B. 900 Hz coplanar apparent resistivity of the southern Styx River Survey, southcentral Alaska, by Burns, L.E., Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2008, 1 sheet, scale 1:63,360. Topography included. $13.

GPR 2008-3-8C. 900 Hz coplanar apparent resistivity of the eastern Styx River Survey, southcentral Alaska, by Burns, L.E., Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2008, 1 sheet, scale 1:63,360. Topography included. $13.

GPR 2008-3-9A. 900 Hz coplanar apparent resistivity of the western Styx River Survey, southcentral Alaska, by Burns, L.E., Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2008, 1 sheet, scale 1:63,360. Resistivity contours included. $13.

GPR 2008-3-9B. 900 Hz coplanar apparent resistivity of the southern Styx River Survey, southcentral Alaska, by Burns, L.E., Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2008, 1 sheet, scale 1:63,360. Resistivity contours included. $13.

GPR 2008-3-9C. 900 Hz coplanar apparent resistivity of the eastern Styx River Survey, southcentral Alaska, by Burns, L.E., and Fugro Airborne Surveys Corp., 2008, 1 sheet, scale 1:63,360. Resistivity contours included. $13.

GPR 2008-4. Linedata and gridded data for the aeromagnetic survey of the Holitna basin area, western Alaska: Parts of the Lime Hills and Sleetmute quadrangles, by Burns, L.E., SIAL Geosciences Inc., and On-line Exploration Services Inc., 2008, 1 sheet, 1 disk. 1 CD-ROM. Download the digital data free of charge. $10.

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NL 2008-1. Alaska GeoSurvey News, by DGGS Staff, 2008, 14 p. Article: The Alaska Volcano Observatory - 20 years of volcano research, monitoring, and eruption response Free.

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PIR 2008-1A. Overview of recent geologic field investigations, North Slope and Brooks Range foothills, Alaska, by Wartes, M.A., and Decker, P.L.

PIR 2008-1B. Measured section and facies analysis of the Lower Cretaceous Fortress Mountain Formation, Atigun syncline, northern Alaska, by Wartes, M.A.

PIR 2008-1C. Evaluation of stratigraphic continuity between the Fortress Mountain and Nanushuk Formations in the central Brooks Range foothills--Are they partly correlative?, by Wartes, M.A.

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PIR 2008-1E. Geochemistry of the Aupuk gas seep along the Colville River--Evidence for a thermogenic origin, by Decker, P.L., and Wartes, M.A.

PIR 2008-1F. Stratigraphic and structural investigations in the Ivishak River and Gilead Creek areas: Progress during 2007, by Decker, P.L., Wartes, M.A., Wallace, W.K., Houseknecht, D.W., Schenk, C.J., Gillis, R.J., and Mongrain, Jacob.

PIR 2008-1G. Turonian-Campanian strata east of the Trans-Alaska Pipeline corridor, North Slope foothills, Alaska: Progress during the 2001-02 and 2007 field seasons, by LePain, D.L., Kirkham, Russell, Gillis, R.J., and Mongrain, Jacob.

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PIR 2008-3A. Surficial-geologic map, Delta Junction to Dot Lake, Alaska Highway Corridor, by Reger, R.D., Stevens, D.S.P., and Solie, D.N., 2008, 48 p., 2 sheets, scale 1:63,360. $31.

PIR 2008-3B. Engineering-geologic map, Alaska Highway corridor, Delta Junction to Dot Lake, Alaska, by

Reger, R.D., and Solie, D.N., 2008, 2 sheets, scale 1:63,360. $26.

PIR 2008-3C. Reconnaissance interpretation of permafrost, Alaska Highway corridor, Delta Junction to Dot Lake, Alaska, by Reger, R.D., and Solie, D.N., 2008, 10 p., 2 sheets, scale 1:63,360. $28.

PIR 2008-3D. Active and potentially active faults in or near the Alaska Highway corridor, Delta Junction to Dot Lake, Alaska, by Carver, G.A., Bemis, S.P., Solie, D.N., and Obermiller, K.E., 2008, 32 p. $4.

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RDF 2008-1 v. 1.0.1. Major-oxide, minor-oxide, and trace-element geochemical data from rocks and stream sediments collected in the northern Fairbanks mining district, Circle Quadrangle, Alaska in 2007, by Athey, J.E., Freeman, L.K., Werdon, M.B., Szumigala, D.J., Lessard, R.R., Newberry, R.J., Hansen, S.E., and Jing, L., 2008, 41 p. $5.

RDF 2008-2 v. 1.0.1. Major-oxide, minor-oxide, trace-element and geochemical data from rocks collected in the Alaska Highway corridor Mount Hayes Quadrangle, Alaska in 2006 and 2007, by Solie, D.N., Werdon, M.B., Newberry, R.J., Freeman, L.K., and Lessard, R.R., 2008, 23 p. $2.50

RDF 2008-3. Preliminary bathymetric map of Mother Goose Lake, Alaska Peninsula, by Schaefer, J.R., Wallace, K.L., and Kassel, C.M., 2008. Free.

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RDF 2008-5. 40Ar/39Ar Ages from the Selawik A-2, A-3, and A-4 and Candle B-5 quadrangles, Alaska, by Layer, P.W., and Solie, D.N., 2008, 14 p. $2.

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RI 2004-1C. Surficial-geologic map of the Salcha River-Pogo area, Big Delta Quadrangle, Alaska, by Reger, R.D., Burns, P.C., and Staft, L.A., 2008, 1 sheet, scale 1:63,360. $13.

RI 2008-1. Bristol Bay-Alaska Peninsula region, overview of 2004-2007 geologic research, by Reifenstuhl, R.R., and Decker, P.L., 2008, 223 p., 3 sheets, scale 1:500,000. $62.

RI 2008-1A. Introduction, by Reifenstuhl, R.R.

RI 2008-1B. Mesozoic and Cenozoic source rock-characteristics, Puale Bay outcrops and North Aleutian Shelf COST #1 Well, by Decker, P.L.

RI 2008-1C. Reservoir quality of 84 Tertiary sandstones from three exploratory wells, Bristol Bay basin, Alaska Peninsula, by Helmold, K.P., Brizzolara, D.W., and Reifenstuhl, R.R.

RI 2008-1D. Reservoir quality of 84 Tertiary sandstones from three exploratory wells, Bristol Bay basin, Alaska Peninsula, by Bolger, G.W., and Reifenstuhl, R.R.

RI 2008-1E. Bear Lake Formation microprobe data, by Hartbauer, C.,

RI 2008-1F. Structural linkage of major tectonic elements in the Ugashik¿Becharof Lakes region, northeastern Alaska Peninsula, by Decker, P.L., Reifenstuhl, A.E., and Gillis, R.J.

RI 2008-1G. Kamishak Formation, Puale Bay, by Whalen, M.T., and Beatty, T.W.

RI 2008-1H. Paleontology and stratigraphy of the Upper Triassic Kamishak Formation in the Puale Bay¿Cape Kekurnoi¿Alinchak Bay area, Karluk C-4 and C-5 quadrangle, Alaska Peninsula, by Blodgett, R.B.

RI 2008-1I. Revised geologic map and structural model of the Staniukovich Peninsula¿Herendeen Bay area, by Decker, P.L., Reifenstuhl, R.R., Gillis, R.J., and Loveland, Andrea.

RI 2008-1J. Fission track geochronology of the North Aleutian COST #1 Well (OCS-8218), Bristol Bay basin, Alaska, by Bergman, S.C., Murphy, J.M., and Kelley, Shari.

RI 2008-1K. Bibliography of selected references, by Reifenstuhl, R.R.

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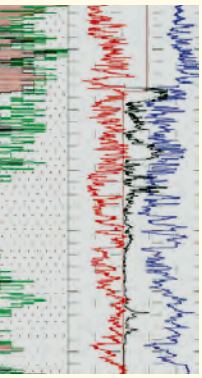
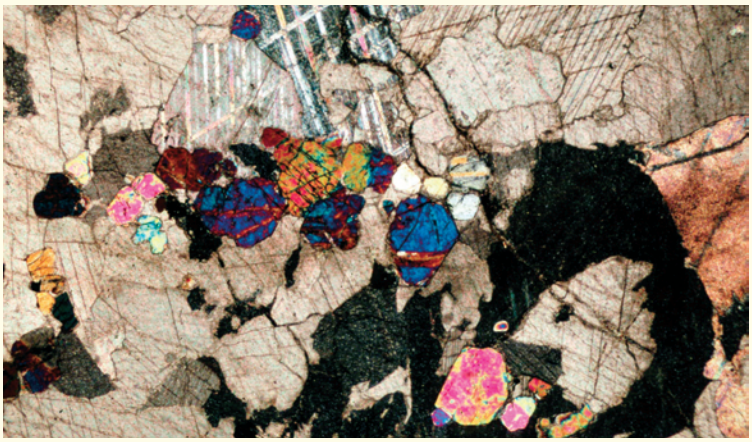
SR 62. Alaska's Mineral Industry 2007, by Szumigala, D.J., Hughes, R.A., and Harbo, L.A., 2008, 89 p. Free.

APPENDIX
Alaska Geologic Materials Center

Alaska Geologic Materials Center





Alaska Department of Natural Resources
Division of Geological & Geophysical Surveys

AGMC Alaska Geologic Materials Center

A vision for responsible stewardship of geologic samples and data in Alaska.

TODAY **TOMORROW**

"A geologist's ability to perform modern analyses on these unique samples is paramount for responsible development of the State's vast resources. It is critical that access to and protection of this valuable resource be improved and updated."

—Bob Swenson
Alaska State Geologist

"Drill core provides the most direct information on the third dimension and is an invaluable resource in interpreting geological history regardless of the application – mineral and energy resources development, construction, environmental or academic; like a great book, it should never be discarded."

—Rick Van Nieuwenhuyse
President and CEO
NovaGold Resources Inc.

An irreplaceable archive of Alaska's geology

The Alaska Geologic Materials Center is the state's principal archive of geologic samples collected by oil and gas exploration companies, mineral exploration companies, geotechnical companies and state and federal agencies.

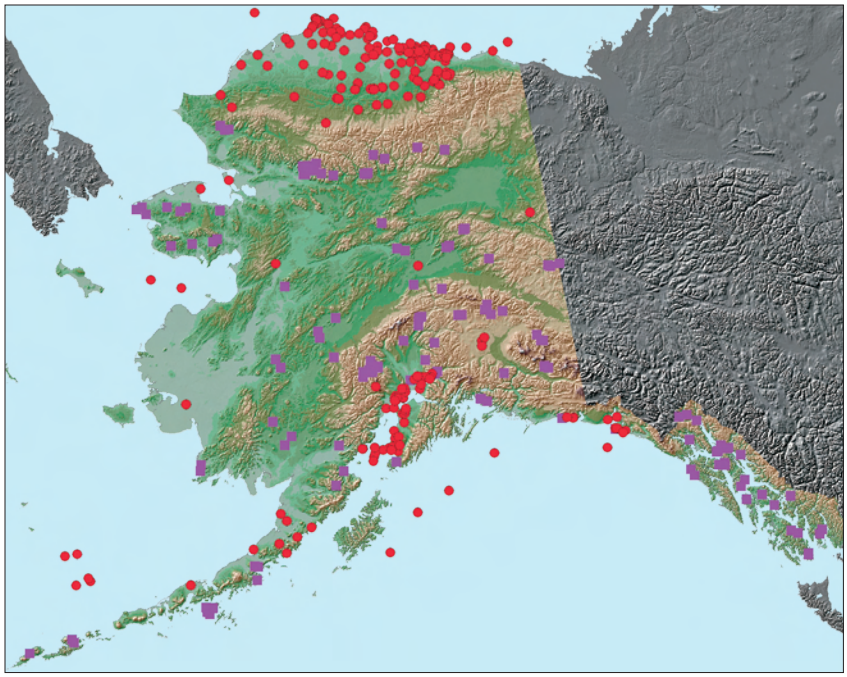
The collection includes unique core samples, surface samples, micropaleontology samples, well cuttings, and geochemical samples.

The AGMC occupies roughly 30,000 square feet of storage area in Eagle River, Alaska.

"The AGMC not only enables me to archive and retrieve samples and data, but its existence ensures that the samples collected by many of us in the industry will remain available in the future for other researchers and explorationists. With the rising cost of exploration, the value of the facility and its collection would be difficult to measure, but it is certain to increase."

—Jeff Foley
Senior Exploration Geologist
Calista Corporation

A century's worth of unique geologic samples from nearly every area of the state



Locations of geologic samples represented at the AGMC.
● = oil- and gas-related samples, ■ = minerals-related samples.

With specimens dating from the present day back to the early 1900s, the Alaska Geologic Materials Center contains

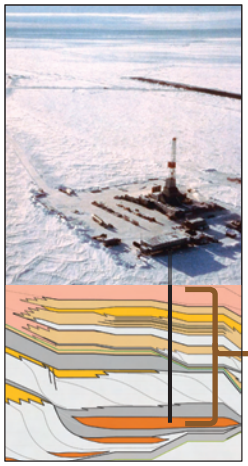
- about 12 million feet of exploration and production drilling, represented in rock core samples and drill cuttings,
- samples from more than 1,450 oil and gas exploratory and production wells from throughout the state,
- nearly a quarter million feet of diamond-drill core samples from over a thousand exploratory hard-rock mineral holes,
- collections donated from the U.S. Minerals Management Service (MMS), U.S. Geological Survey (USGS), U.S. Bureau of Mines, U.S. Bureau of Land Management (BLM), Alaska Oil and Gas Conservation Commission (AOGCC), Amoco, BP, Shell, Marathon, Phillips, Unocal, Kennecott, Aleut Corporation, and many others,
- more than 260,000 glass slides for microscopic analyses,
- more than 300 data reports on sample analyses.

"Core, slides, and rock donations by the many oil companies that have been bought up by others, or that have lost interest in the State, have been preserved at the Alaska Geologic Materials Center. Luckily, we can still view the materials due to the foresight of the State and the donating companies. This is an invaluable resource that needs to be preserved and made more accessible."

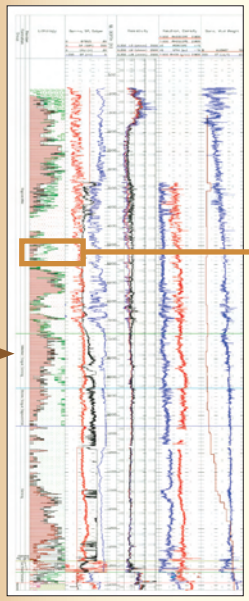
—David C. Shafer, Development Geologist Advisor
Chevron North America Exploration and Production

The exploration, sampling, and storage process

Rock samples from oil and gas exploration are obtained by drilling into the earth, often at very remote locations.

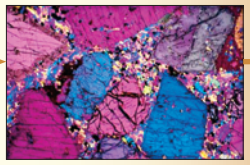


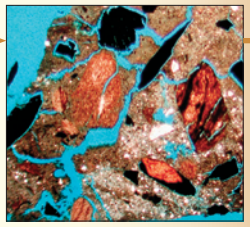
The well log shows properties of the rock from the surface down to the bottom of the drilled hole. AGMC samples are required to calibrate the log.



Drill core samples are labeled with the depth in feet (white lettering, top), and archived at the AGMC (bottom).

Photomicrographs from thin sections of the core samples allow detailed analysis of the rock.





Ultimately, analysis based on AGMC archives and data leads to resource discovery and production.

EXPLORATION ANALYSIS PRODUCTION

"The Alaska Geologic Materials Center is an extremely valuable resource to the Alaska oil & gas industry. Results from studies on AGMC cores can strongly influence exploration decisions. However, the AGMC is grossly antiquated and this precludes efficient use of its resources. The AGMC absolutely needs to be upgraded, both in terms of its physical plant and its online database capabilities."

—Thomas Homza, Staff Geologist
Shell Exploration & Production Co.

Our vital role in future resource development

Sam Dashevsky, Northern Associates, Inc.

- Many successful prospects across the state were initially identified in the rock samples at AGMC.
- Each year, the AGMC's samples are inspected or analyzed by 400–500 clients from industry, government, and academia.
- Since 2005, about 80 percent of the AGMC's clientele has represented energy interests, while 20 percent has been concerned with mineral exploration and development.
- Modern sophisticated analysis of archived samples is widely recognized as a cost-effective alternative to the tremendous expense of core drilling and resampling in the field.
- One foot of core can provide critical information to an exploration/development company, potentially leading to discovery and ultimately to millions of dollars in lease, tax, and royalty revenue to both state and federal governments.

"The ability to catalog, inventory, recover and examine core and geologic data from past exploration projects in Alaska is of tremendous value to the minerals industry. Having improved access will advance the exploration-discovery process and decrease the time and expense required for the future development of new ore deposits."

—Jeffrey A. Pontius
President & CEO
International Tower Hill Mines Ltd.

Challenges facing the AGMC

The current AGMC facility lacks sufficient space and equipment for proper sample storage, processing, layout, and viewing.

- Available heated warehouse space has long been exceeded.
- Half of the collection is in 55 unheated, unlighted portable shipping containers, endangering the samples by exposing them to large changes in temperature and humidity.
- It is nearly impossible to perform routine core analysis on large-footage wells—the cores must be taken off-site, endangering the samples.
- The facility is unsecured, and has high fire and other risks.
- With the collection scattered among numerous buildings and shipping containers, access to data is poor.

"The AGMC's presentation doesn't befit its contents. Moreover, it speaks of lost opportunities to educate—not just geoscientists, but school kids, the general public, perhaps even tourists, about the abundant natural resources of Alaska."

—Denise M. Stone
Exploration Advisor
Benchmark Oil and Gas

Moving toward a better position on the storage spectrum

POOR ——— **EXCELLENT**

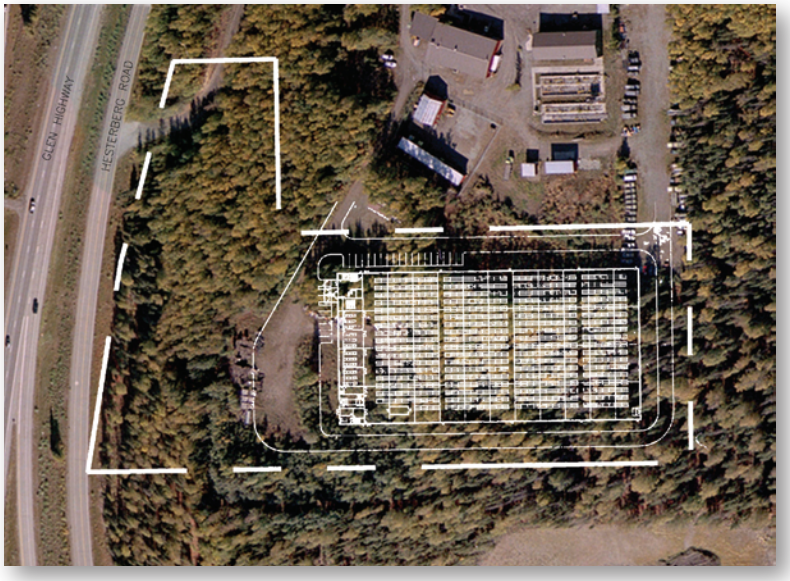
Foreign country
Unorganized and unmaintained, the valuable information once held by these core samples is lost.

Alaska
The current AGMC facility has limited workspace, is 150% over capacity, and is poorly designed for geologic sample storage.

U.S. and Canada
Modern facilities include Alberta Core Research Center (bottom), Oklahoma Geological Survey, Texas Bureau of Economic Geology (top), and U.S. Geological Survey Denver.

Taking steps to protect current and future collections

- In 2005, an ad hoc committee—with representatives from the energy and mining industries, the federal government, and the State of Alaska—developed criteria for a new, expanded and centralized Alaska Geologic Materials Center.
- In April of 2006, members of the committee met with architects, engineers, and a national expert in the design of geologic materials centers.
- The resulting design concept study has now been completed, including conceptual design of a 125,000 square foot facility that will accommodate growth well into the 21st century.
- 9.5 acres of state-owned property in Eagle River are available as a building site.
- Project is underway to link the AGMC sample database to the DGGS website for fast, online archive searches by explorers.



"…if a new repository is not developed soon, the State of Alaska, federal agencies, private industry, and the public will be at risk of losing irreplaceable scientific resources."

—2006 AGMC Concept Study

Alaska Geologic Materials Center

Alaska's archive of geologic materials in support of resource exploration, land-use management, and research

For more information, contact
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www.dggs.dnr.state.ak.us