Alaska Division of Geological & Geophysical Surveys Annual Report 2012

State of Alaska
Department of Natural Resources
Division of Geological &
Geophysical Surveys
January 2013

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Cover photo: Geologists Marwan Wartes (Alaska Division of Geological & Geophysical Surveys, bottom) and Rick Stanley (U.S. Geological Survey) examine a thick coal bed in the Lignite Creek Formation (Usibelli Group) near Wood River, about 60 miles south of Fairbanks. During May 2012, DGGS, in collaboration with the Alaska Division of Oil & Gas and USGS conducted a 10-day reconnaissance geologic field study along the northern foothills of the Alaska Range. This work addresses several formations that are relevant to potential petroleum source and reservoir rocks in the Nenana basin west of Fairbanks. The team also collected field data and samples to document the basin's structural evolution. The project provides important and timely geologic information for an area of active exploration and is relevant to evaluation and management of potential oil and gas resources near Fairbanks. A report outlining DGGS's initial findings will be released during early 2013. Support for this project comes from State capital improvement funds. Photograph by Trystan Herriott.

State of Alaska
Department of Natural Resources
Division of Geological & Geophysical Surveys
January 2013

STATE OF ALASKA
Sean Parnell, *Governor*

DEPARTMENT OF NATURAL RESOURCES
Daniel S. Sullivan, *Commissioner*

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

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Director's Foreword

Change is one of the most common themes I can think of when observing local, national, and global trends. Whether it is the natural environment, the economy, or natural-resource supply and demand, change is evident at nearly every scale, and in nearly every sector of our society. Our ability to adapt to constant and ubiquitous change is paramount to maintaining a healthy economy, environment, and lifestyle.

Planning, budgeting, and implementing a strategy in a world that is in constant flux can be very challenging. The issues of the day may or may not be the issues of tomorrow, and predicting what will be the most important focus for limited resources requires flexibility and a firm grounding in the basics. Focusing on the basics is what we do best at the Division of Geological & Geophysical Surveys (DGGS), and the baseline information we provide helps our state plan and adapt to inevitable change.

We can all remember historic projects that were based on predictions of the day and good intentions, only to be curtailed prematurely because of changing needs, markets, and public support. Correctly avoiding or altering efforts that are likely to fail because of change is rooted in reliable data, a deep appreciation of history, and flexibility in the way forward. Effective planning must incorporate change–sometimes significant change–as a real possibility, especially in long-term projects. Maintaining a close relationship with baseline data helps provide that flexibility.

The geology of Alaska is likewise dominated by change, yet those changes are exceedingly slow on human time scales. For example, the accumulation of oil, gas, and coal takes many tens of thousands or even millions of years, and the process of mineralization, uplift and ultimate exposure of valuable minerals at the earth's surface is equally time consuming. The formation of mountains and sedimentary basins is the cumulative result of hundreds of thousands of discrete and locally devastating earthquakes over hundreds of thousands of years. Luckily, all these events leave their marks in the rocks, and with careful study we can piece together the history and help predict where new resources can be found and the likelihood of future major volcanic and earthquake events, which all play a key role in securing our economic growth and the safety of our infrastructure and population.

The staff at DGGS works very hard to provide unbiased scientific information that is needed in planning for change. Whether it is for resource exploration, sound policy decisions, or public education, the information that disseminates from our work provides the foundation for successful planning. The Alaska public can be assured the data produced by DGGS is of the highest quality and absent political or special-interest influence.

Our 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 a wide range of topics that provide baseline information on energy resource potential, from industrial–export to local–consumptive scales; solid-minerals assessments that will help the State identify our resource endowment in strategic minerals; and natural-hazards assessments that are crucial to adapting to environmental change, securing public safety, and protecting the State's investments in infrastructure.

I strongly encourage you to read the program descriptions included in this report, and 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, environmentally sound, and adaptable to change—well into the future.

Robert 'Bob' Swenson, State Geologist and Director
Division of Geological & Geophysical Surveys

DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS
ANNUAL REPORT 2012

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. (1 ch 93 SLA 1972)

LOCATION

The Division's administrative headquarters and personnel moved from Anchorage 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 faculty and students are important adjunct members of many DGGS project teams.

ORGANIZATION

DGGS is one of seven divisions and four 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 (see organizational chart). The Division also administers the 11-member Alaska Seismic Hazards Safety Commission.

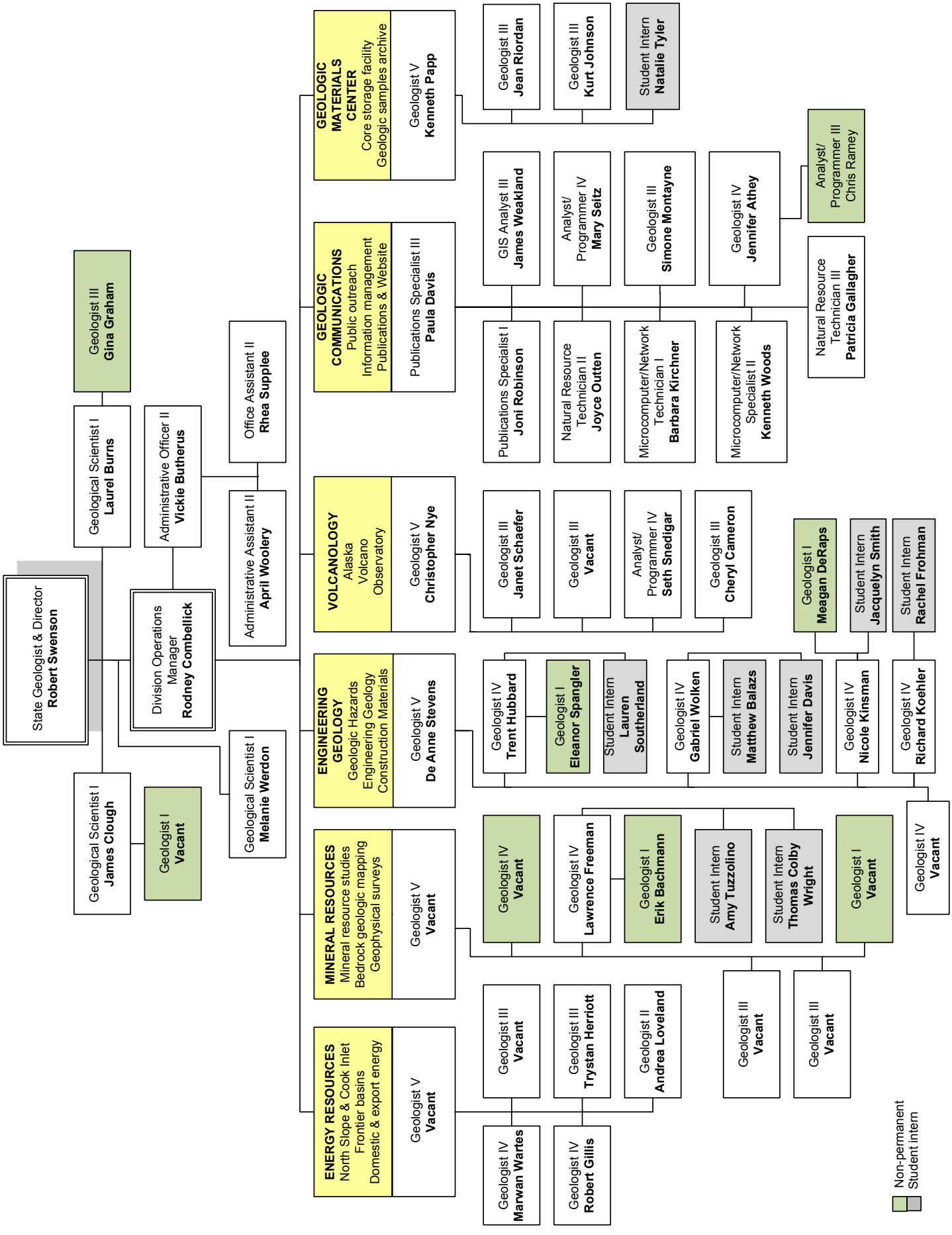
Current DGGS staff totals 40 permanent full-time professional and support positions, a Director, Division Operations Manager, eight nonpermanent staff, and eight student interns.

Division of Geological & Geophysical Surveys offices in Fairbanks

Geologic Materials Center in Eagle River

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

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.


State Geologist & Director
Robert Swenson
Division Operations Manager
Rodney Combellick
Administrative Officer II
Vickie Butherus
Office Assistant II
Rhea Supplee
Administrative Assistant II
April Woolery
Geologist III
Gina Graham
Geological Scientist I
Laurel Burns
Geological Scientist I
James Clough
Geologist I
Vacant
Geological Scientist I
Melanie Werdon
GEOLOGIC MATERIALS CENTER
Core storage facility
Geologic samples archive
Geologist V
Kenneth Papp
Geologist III
Jean Riordan
Geologist III
Kurt Johnson
Student Intern
Natalie Tyler
GEOLOGIC COMMUNICATIONS
Public outreach
Information management
Publications & Website
Publications Specialist III
Paula Davis
GIS Analyst III
James Weakland
Analyst/ Programmer IV
Mary Seitz
Geologist III
Simone Montayne
Geologist IV
Jennifer Athey
Analyst/ Programmer III
Chris Ramey
Publications Specialist I
Joni Robinson
Natural Resource Technician II
Joyce Outten
Microcomputer/Network Technician I
Barbara Kirchner
Microcomputer/Network Specialist II
Kenneth Woods
Natural Resource Technician III
Patricia Gallagher
VOLCANOLOGY
Alaska Volcano Observatory
Geologist V
Christopher Nye
Geologist III
Janet Schaefer
Geologist III
Vacant
Analyst/ Programmer IV
Seth Snedigar
Geologist III
Cheryl Cameron
Geologist I
Meagan DeRaps
Student Intern
Jacquelyn Smith
Student Intern
Rachel Frohman
ENGINEERING GEOLOGY
Geologic Hazards
Engineering Geology
Construction Materials
Geologist V
De Anne Stevens
Geologist IV
Trent Hubbard
Geologist I
Eleanor Spangler
Student Intern
Lauren Southerland
Geologist IV
Gabriel Wolken
Student Intern
Matthew Balazs
Student Intern
Jennifer Davis
Geologist IV
Nicole Kinsman
Geologist IV
Richard Koehler
MINERAL RESOURCES
Mineral resource studies
Bedrock geologic mapping
Geophysical surveys
Geologist V
Vacant
Geologist IV
Vacant
Geologist IV
Lawrence Freeman
Geologist I
Erik Bachmann
Student Intern
Amy Tuzzolino
Student Intern
Thomas Colby Wright
Geologist I
Vacant
Geologist IV
Vacant
ENERGY RESOURCES
North Slope & Cook Inlet
Frontier basins
Domestic & export energy
Geologist V
Vacant
Geologist III
Vacant
Geologist III
Trystan Herriott
Geologist II
Andrea Loveland
Geologist III
Vacant
Geologist III
Vacant
Geologist IV
Marwan Wartes
Geologist IV
Robert Gillis
Non-permanent
Student intern

L TO R: Trystan Herriott , Marwan Wartes, Jim Clough, Andrea Loveland, Bob Gillis

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 potential local sources of energy for rural Alaska villages and enterprises.

BACK L TO R: Larry Freeman, Erik Bachmann, Melanie Werdon
FRONT L TO R: Gina Graham, Laurel Burns

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 aid in the state's management of mineral development, and help to encourage mineral exploration in Alaska, which provides employment opportunities and revenue for Alaska's citizens.

L TO R: Gabriel Wolken, Nicole Kinsman, Jacquelyn Smith, Trent Hubbard, Richard Koehler, Lauren Southerland, Meagan DeRaps
KNEELING: De Anne Stevens

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 sources of construction materials and placer minerals. Studies of major geologic hazards such as earthquakes, active faults, coastal flooding and erosion, 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.

The **Volcanology Section,** established in 2007, focuses on processes and hazards associated with the more than 50 active volcanoes in Alaska. The section is home for the DGGS participants in 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 volcano-hazard risks. Results of these studies are released as maps and reports. The section also creates and maintains a very large, public, web-accessible database of information on volcano history and current activity (http://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, participating in state activities leading up to the geothermal lease sale at Mt. Spurr, and providing technical reviews of proposals to the Renewable Energy Fund established by HB152 in 2008.

L TO R: Chris Nye, Cheryl Cameron, Janet Schaefer, Seth Snedigar

The **Geologic Communications Section** publishes and delivers Division-generated geologic information to the public and maintains and improves public access to Alaska's geologic and earth science information. Advances in computer technology have resulted in faster preparation of maps and reports and a wider awareness of DGGS's available Alaska geologic resources. This section designs, implements, maintains, and improves a database for the Division's digital and map-based geological, geophysical, and geochemical data; a database for the Division's physical samples that are housed in Eagle River; and websites for the Division (http://www.dggs.alaska.gov), the Alaska Seismic Hazards Safety Commission (http://www.seismic.alaska.gov), and the Association of American State Geologists (http://www.stategeologists.org).

BACK L TO R: Jim Weakland, Bobby Kirchner, Joyce Outten, Joni Robinson, Susan Seitz, Ken Woods
FRONT L TO R: Jen Athey, Trish Gallagher, Simone Montayne
MISSING: Paula Davis, Chris Ramey

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 analyses of the geologic materials stored there must be returned to the GMC database in the form of data reports.

L to R: Kjol Johnson, Joe Skutca, Kurt Johnson, Don Hartman, Jean Riordan, Ken Papp

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 damage from 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, http://www.seismic.alaska.gov.

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 and gas lease tracts; area plans; competitive coal leases; geologic assessments of land

trades, sales, selections, or relinquishments; mineral potential; and construction materials availability. The DGGS Energy Resources Section works closely with geologic personnel in the Division of Oil & 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 works with the Division of Economic Development in the Department of Commerce, Community & Economic Development (DCCED), to report on the status of Alaska's mineral industry. The Engineering Geology Section works closely with the Division of Homeland Security & Emergency Management (DHSEM) in the Department of Military and Veterans Affairs to evaluate hazards, develop scenarios for hazards events, and update the State Hazard Mitigation Plan. Engineering Geology staff also work closely with DCCED, the Department of Transportation & Public Facilities, University of Alaska Fairbanks, and other agencies to assess the impacts of flooding, erosion, and other processes potentially accelerated by climate change, and with the Alaska Energy Authority to evaluate hazards to proposed hydroelectric, geothermal, and other energy projects. The Volcanology Section works with DHSEM and the Division of Environmental Conservation to mitigate risks from eruptions, and with the Alaska Energy Authority to provide technical expertise concerning geothermal resource potential. DGGS also evaluates resource potential around the state that may provide viable alternatives for energy development in rural Alaska. In recent years, DGGS has developed close working relationships with the Alaska Pipeline Project Office, Alaska Gasline Development Corporation, and the State Pipeline Coordinator's Office to assist in geologic data collection and hazards risk assessment for proposed natural gas pipelines.

Funding to support work requested by other DNR agencies mostly has been drawn from DGGS's annual general fund appropriation. However, for larger inter-division or other one-time efforts responding to special needs, the work is often 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, Seldovia, Seward, Whittier, and Valdez, communities for which inundation maps have been prepared in recent years, 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 Sitka and Cordova for the next tsunami-inundation maps to be generated by this program. The Engineering Geology Section has worked closely with several communities to develop MapTEACH, a field-geoscience outreach program for middle- and high-school students in rural Alaska. Engineering Geology also works with coastal and river communities to help assess hazards and alternatives for mitigating the effects of erosion, flooding, and other surface process that threaten sustainability of the communities. Similarly, the Energy Resources Section has worked closely with rural communities to help assess potential local energy resources as alternatives to importing expensive diesel fuel.

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 Fairbanks. UAF 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

through research intern programs established recently through Memoranda of Agreement with the UAF Department of Geology & Geophysics and Department of Mining & Geological Engineering. DGGS and the University make frequent use of each other's libraries and equipment. DGGS's Volcanology Section has a long-term cooperative relationship with the UAF Geophysical Institute resulting from partnership in the Alaska Volcano Observatory. University faculty and students occasionally visit the Geologic Materials Center in Eagle River to study the geology represented in cores and surface samples from around the state.

RELATIONSHIPS WITH FEDERAL AGENCIES

DGGS periodically 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. In the past, DGGS has also engaged in cooperative programs with the U.S. Minerals Management Service (MMS; now the Bureau of Ocean Energy Management, or BOEM), 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 federal funds to support mineral inventory mapping, surficial and earthquake hazards-related mapping, volcanic-hazards evaluations, and studies related to oil & gas and geothermal 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 support. Federal funding is pursued only for projects that are needed to advance the division's statutory mission.

Two ongoing cooperative programs with federal agencies have provided support for key elements of the DGGS mission for many 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 administered by USGS. STATEMAP provides matching funds for geologic-mapping projects according to priorities set by the Alaska Geologic Mapping Advisory Board (see below).

DGGS has been successful in receiving cooperative agreements for two new key federal programs, the National Geological & Geophysical Data Preservation Program (NGGDPP) and the Coastal Impact Assistance Program (CIAP). The NGGDPP, established by the National Energy Policy Act of 2005 and funded by USGS, supports several DGGS projects to archive, catalog, and make publicly available inventories of geologic samples and data through a National Digital Catalog hosted by USGS. DGGS received major, multi-year CIAP support through a highly competitive proposal process administered originally by MMS and currently by the U.S. Fish & Wildlife Service. CIAP funding supports DGGS geologic mapping and hazards evaluations of coastal communities in western Alaska that are potentially impacted by Outer Continental Shelf petroleum development and face current risks from coastal erosion and storm-wave flooding.

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 review and advise on priorities for geologic mapping recommended by the State Geologist and provide letters of support to accompany DGGS's annual STATEMAP proposals to the U.S. Geological Survey.
- 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. Board members nominate candidates to fill vacancies and the State Geologist makes the appointments with approval of the Commissioner of DNR.

Current members of the board are:

Curt Freeman, Chair

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, earthquake 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.

Tom Homza

Shell Exploration and Production, Alaska, representing petroleum industry interests with emphasis on the North Slope.

Tom Homza is a Principle Regional Geologist for Alaska at Shell with 16 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 College of Natural Science and Mathematics, representing the academic community.

Dr. Paul Layer is Dean of the College, a Professor of Geophysics, and former Chair of the Department of Geology & Geophysics.

Steve Masterman

Engineering Geologist, Alaska Department of Transportation & Public Facilities (DOTPF), representing state government and the engineering geology and geotechnical community.

Steve Masterman is Regional Engineering Geologist for the Northern Region office of DOTPF, overseeing geotechnical studies in support of development and maintenance of the region's highways and airports.

Lance Miller

Nana Regional Corporation, representing Alaska Native corporation interests.

Lance Miller is Vice President for Resources and a geologist with mineral exploration background.

2012 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 2012 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.

ENERGY RESOURCES

- Finalized a major five-year effort to compile energy-related data in all regions of the state and published Special Report 66, which provides a complete review, recommendations, and bibliography of reports that can be used to guide energy development in rural Alaska.
- Conducted new field work in the Cook Inlet basin, with a shift from the focus of 2011 studies of the Cenozoic rocks of upper Cook Inlet to new studies of the lower Cook Inlet's Mesozoic rocks. This work included detailed stratigraphic studies that bear on petroleum source rock distribution and reservoir potential in the Mesozoic section.
- Collected new data to further our understanding of the Cook Inlet basin's tectonic evolution.
- Led a two-day field tour in July 2012 for industry and state officials to examine the petroleum reservoir potential of Mesozoic rocks and the structure of the Cook Inlet's basin margin.
- Conducted reconnaissance geologic field work in the Tanana basin along the north side of the Alaska Range for

the In-State Gas Potential program. This field work addressed several stratigraphic units that are relevant to the petroleum source and reservoir rocks in the Nenana basin west of Fairbanks.

- Completed 810 square miles of geologic field mapping and detailed stratigraphic studies in the Umiat area of the North Slope to better constrain the distribution of potential hydrocarbon reservoirs and improve the overall understanding of the North Slope petroleum province's framework geology.
- Began evaluating the shale oil potential on the North Slope with initial field studies focused on the world class oil source rocks in the Triassic Shublik Formation. This work is in collaboration with the University of Alaska Fairbanks' Department of Geology & Geophysics and the U.S. Geological Survey.
- In collaboration with the U.S. Geological Survey, completed and published the first ever detailed study of feed-coal and fly-ash compositions for a Fairbanks area coal-fired power plant. This study analyzed for a large suite of coal combustion products that, if present in high concentrations, can potentially have a significant impact on the environment when the coal is burned and the fly ash is disposed.
- Compiled and submitted published and unpublished data on Alaska thermal springs, aqueous chemistry, active faults, Makushin and Akutan core lithology descriptions, and Quaternary and younger volcanic vents to the National Geothermal Data System, which is part of a national database of geothermal information for all 50 states.
- Presented new data relevant to oil and gas exploration of the North Slope at the annual meeting of the American Association of Petroleum Geologists, held in Long Beach, California, and at a Fold & Thrust Belt Workshop hosted by the Alaska Geological Society in Anchorage, Alaska.
- Presented data on North Slope and Cook Inlet stratigraphy and tectonics at the University of Alaska Fairbanks, Department of Geology & Geophysics Friday Seminar.
- Hosted an information booth at the annual meeting of the American Association of Petroleum Geologists held in Long Beach, California, and discussed oil and gas opportunities in Alaska with meeting attendees.
- Completed an evaluation of coal-lease mining potential for an industry lease application in the Canyon Creek area near the Skwentna River in the upper Cook Inlet basin.
- Presented data on the sequestration of CO_2 in coal seams statewide at the Association of Engineering & Environmental Geologists annual meeting held in Anchorage, Alaska.

MINERAL RESOURCES

- Published *Alaska's Mineral Industry 2011 – Exploration Activity* (Special Report 67), an authoritative annual report of statewide mineral exploration activity.
- Initiated the Strategic and Critical Minerals Assessment project to assess Alaska's strategic and critical minerals (SCMs) potential. Digitally compiling historical and obtaining new statewide SCM data.
- Participated in the Governor's Strategic and Critical Minerals Summit in Fairbanks. This public forum provided global and national perspectives on strategic and critical mineral resources and issues, highlighted Alaska's mineral wealth and research capabilities, and encouraged industry exploration, development, production, and processing of strategic and critical minerals in Alaska.
- Contracted for airborne geophysical surveys of 1,029 square miles of three areas adjacent to the previously flown Aniak or Iditarod surveys, western Alaska and 1,049 square miles in the Farewell area, south-central Alaska. Acquired all data for the Aniak-Iditarod suburbs and 145 square miles of the Farewell survey.
- Conducted rock, stream-sediment, and pan-concentrate geochemical sampling, as well as associated geologic studies and a mineral-resource assessment of 3,500 square miles in the Ray Mountains-Dalton Highway area, Interior Alaska.
- Published poster of Alaska's mineral resources.
- Published geochemical report for the Ray Mountains-Dalton Highway area, Interior Alaska.
- Published geochemical report for the Moran area, Interior Alaska.
- Published geochemical report for the Western Moran area, Interior Alaska.
- Published geochemical report for the William Henry Bay area, Southeast Alaska.
- Completed draft bedrock geologic map of 301 square miles of the Moran area, Interior Alaska.
- Supported the Division of Mining, Land & Water and the U.S. Bureau of Land Management by providing extensive mineral-resource reviews for area plans and state land sales.
- Provided mineral-resource-potential evaluations of state land throughout Alaska, to identify and prioritize appropriate land to relinquish from the State of Alaska's over-selected land entitlement.
- Presented four talks on the DGGS Moran, Ray Mountains, and Strategic and Critical Minerals projects.
- Responded to over 850 public, industry, and agency requests for mineral resources information.

ENGINEERING GEOLOGY

- Conducted geologic fieldwork along the Alaska and Parks highways in support of proposed export and in-state natural gas pipeline projects.
- Completed geologic fieldwork in Whittier, Nome, Golovin, Shishmaref, Wales, Seward, and Valdez in support of community-based hazards evaluation projects.
- Published a legacy engineering-geologic map with accompanying GIS data in support of geologic studies in the Fortymile mining district.

- Published surficial-geologic and permafrost maps with accompanying GIS data in support of geologic and hazards studies along the Alaska Highway between Tetlin Junction and the Canada border.
- Completed and released the "Quaternary Faults and Folds in Alaska" database.
- Published a paleoseismic-neotectonic report documenting observations related to potential active faulting along the Alaska Highway corridor between Tetlin Junction and the Canada border.
- Published a report on the potential socioeconomic effects of Pacific Northwest earthquakes on Alaska.
- Published two large collections of spatially referenced aerial photographs of the coast of northwest Alaska in support of coastal hazards assessments.
- Published an annotated bibliography in support of community hazard planning efforts in northwest Alaska.
- Published a comprehensive report of post-storm field data collected in northwest Alaska in the aftermath of the November 2011 Bering Sea storm.
- Published a digital elevation model (DEM) of Sitka Harbor in support of tsunami hazards modeling efforts.
- Published five papers in outside professional journals or government reports.
- Presented talks and posters at numerous state, national, and international venues, to inform the geologic community and government representatives about DGGS Engineering Geology geologic studies, with the primary goals of disseminating geologic information and encouraging informed planning and development in Alaska.
- Supported the Alaska Energy Authority by reviewing alternative energy project proposals for potential geologic hazards that should be addressed in project implementation.
- Completed agency reviews regarding potential geologic hazards and engineering-geologic considerations for multiple DNR land disposals, resource development and subdivision projects, and large project exploration and development plans for the federal Bureau of Ocean Energy Management, Environmental Impact Statements of the U.S. Bureau of Land Management (BLM), resource reports for the Federal Energy Regulatory Commission, and study plans for the Alaska Energy Authority.
- Led teacher and student activities and workshops in Fairbanks, Anchorage, and Metlakatla as part of DGGS's ongoing involvement in MapTEACH (Mapping Technology Experiences with Alaska's Community Heritage), a geoscience education-outreach collaboration with the University of Alaska.
- Provided administrative and scientific support for the Alaska Seismic Hazards Safety Commission. The Commission produces a separate annual report.
- Participated in collaborative research with the U.S. Geological Survey on Sedanka Island, Alaska, to examine the timing of past great earthquakes and tsunamis along the Aleutian subduction zone in order to assess the recurrence of these earthquakes and segmentation patterns along the Aleutian trench.
- Initiated a major new multi-year study to assess the role and potential impacts of a glacierized source basin on the proposed Susitna-Watana Hydroelectric Project, and the potential effects of climate change over the life of the project.
- Completed a very high-resolution airborne lidar (Light Detection and Ranging) survey covering a 50-square-mile area around Whittier in support of geologic mapping and hazards evaluations.
- Three section members were nominated for the Governor's Denali Peak Performance Award, one of whom received Honorable Mention.

VOLCANOLOGY

- Conducted the eighth consecutive year of water quality monitoring at drainages from Chiginagak volcano by collecting and analyzing water samples. The monitoring, partially supported by the U.S. Fish and Wildlife Service, is in response to a 2005 acid flood event which originated in the crater lake, and temporarily devastated salmon runs in the King Salmon River and Mother Goose Lake.
- Conducted additional field work at Kasatochi volcano in support of geologic mapping and volcanological studies. Rapid erosion of the 2008-eruption pyroclastic flows continues to expose previously-inaccessible outcrops of underlying volcanic deposits. A draft geologic map will be finished in early 2013.
- Obtained (with University of Alaska Fairbanks Geophysical Institute graduate student Owen Neill) 3,000 mineral analyses from samples spanning the stratigraphic and compositional diversity of all Kasatochi units as an aid to furthering understanding of the processes that produce Kasatochi magmas.
- Coauthored a detailed manuscript on the petrogenesis of Kasatochi 2008 magmas, which has been submitted to the Journal of Volcanology and Geothermal Research.
- Coauthored a paper on quenched mafic inclusions in Augustine Volcano lavas, which was published in International Geology Review.
- Oversaw the production of a post-2008 eruption DEM of Okmok caldera and published the DEM and its description (DGGS RDF 2011-6).
- As lead author of an interagency team of sixteen authors, published a detailed account of the 2009 Redoubt eruption (DGGS RI 2011-5).
- Authored a map of ashfall thickness and distribution from the 2009 Redoubt eruption (DGGS MP143).
- Coauthored a paper on a regional tephra in Alaska and northwestern Canada (Quaternary International, v. 246, p. 312–323).
- Created and coordinated AVO's web celebration of the centennial anniversary of Novarupta's 1912 eruption, including timeline, slideshow, references, Twitter feed, and video (https://www.avo.alaska.edu/Katmai2012/).

- Compiled detailed locations, descriptions, age, and morphology information for the more than 400 Holocene volcanic vents in Alaska. Many vents were unpublished, published only in gray literature, or published in otherwise awkward venues.
- Continued development of GeoDIVA, the database that feeds the AVO website. Increased the total recorded samples to ~10,700 (from ~9,300), verified and loaded additional geochemical data (number of samples with analyses is now ~5,600; up from ~3,650), and updated the bibliography (now ~4,700 references). Release of a major GeoDIVA enhancement – whole-rock geochemistry of samples from Quaternary volcanoes – is expected in the coming year. Procured and provided logistical coordination and support for interagency AVO flight activities throughout Alaska.
- Responded to more than 300 emails to the Alaska Volcano Observatory.

GEOLOGIC COMMUNICATIONS

- Published 27 new geologic maps and reports (total 840 pages, 12 sheets, 8 disks or databases). New publications include high-resolution lidar data (2.2 terabytes) for an infrastructure corridor across Alaska; an ash fall contour map of the 2009 eruption of Redoubt Volcano; information on fossil fuel and geothermal energy sources for local use in Alaska; geochemical trace-element and rare-earth element data from samples collected in 2011 in the Melozitna mining district; and Alaska's Mineral Industry 2011 – exploration activity.
- Distributed 2,900 hard-copy publications, 2,880 digital data files via free downloads from the DGGS website (http://www.dggs.alaska.gov), responded personally to hundreds of significant geologic information requests (most from the online "Ask a Geologist" feature), and recorded nearly 5.15 million web page views, a 41 percent increase from 2011. The highest demand new product was high-resolution lidar data collected to provide background geologic information for a proposed Alaska infrastructure corridor (1,951 downloads plus ten complete copies of the 2.2 TB dataset). Still a hot seller is the deck of educational playing cards with photos and other information about each of the 52 historically active Alaska volcanoes—1,599 additional decks were sold without any advertising to locations as distant as New Zealand, Italy, and Iceland, among others.
- Ongoing maintenance and updates to the DGGS website. New upgrades to the underlying code allow us to more efficiently increase and manage website content.
- Ran the Alaska Seismic Hazards Safety Commission (ASHSC) and Association of American State Geologists (AASG) websites. The ASHSC website provides information pertaining to the Commission's work to develop recommendations for seismic-risk mitigation to improve public safety in Alaska. DGGS is currently working with the AASG executive committee to develop a long-term document management and information retention plan.
- Remodeled the publications database framework and new metadata schema to support the release of 2.2 TB of lidar digital data products.
- Maintained and continued to improve the DGGS production database, web applications, and services including Publications, Geospatial Data Application (D3), WebGeochem, and DGGS metadata.
- Developed a site map method for dynamically providing catalog data of DGGS geologic sample collections as part of the U.S. Geological Survey's National Geological and Geophysical Data Preservation Program (NGGDPP).
- Released the Alaska Geologic Data Index (AGDI), formerly known as Alaska Mineral Industry Data Index (AKMIDI) database, an online map- and text-based search application containing documentation for almost 17,000 previously unpublished datasets.
- Continued development and migration of the web application for the Alaska Paleontology Database, a web-based guide to more than 15,000 samples connecting more than 1,900 citations of Alaska fossils.
- Developed a new Alaska geophysics website, Airborne GeophysWeb, a web-based visual guide to DGGS geophysics data and publications.
- Provided database design and support to the Geographic Information Network of Alaska (GINA) as part of the development of the Geologic Map Index web application.
- Quality assured the entry into the GMC surface sample database of the DGGS minerals sample inventory of 2012 GMC shipments.
- Added citations and links and/or scanned materials for about 300 additional non-DGGS reports (U.S. Geological Survey, U.S. Bureau of Mines, UAF Minerals Industry Research Lab). Most of these were reports published by the USGS after 2002.
- Worked collaboratively to incorporate significant automations in the metadata compilation and loading process, thus allowing GeoComm staff to assume more responsibility for metadata compilation and relieving the geologic staff of significant metadata work. The net result is several days of production time shaved per publication.
- Successfully created and began using a standardized geologic map template in ArcGIS for Desktop. Along with some basic training, the template helped DGGS geologic staff to create maps faster, with all of the necessary elements, while following the new NCGMP09 geodatabase standard for geologic maps.
- Set up hardware and software and implemented ArcGIS for Server at DGGS. Currently have one public interactive web map using services from the server; more are being developed.
- Assisted DGGS geologic staff with GIS/cartographic tasks for posters and figures for numerous publications, projects, and presentations. Taught GIS users new, more efficient methods to produce illustrations using ArcGIS.
- Provided support for the following conferences by having a significant presence at each: Association of

Environmental & Engineering Geologists, Anchorage; Alaska Miners Association Annual Conference, Anchorage; and the Alaska Miners Association biannual conference, Fairbanks.

- Sent out Earth Science Kits to bush communities and continued to make available our geological publications to all levels of educational providers.
- Provided support to produce and publish Annual Seismic Hazards Safety Commission Report; AASG state postcards; and update of the MapTEACH curriculum.
- Scanned, converted to PDF, and archived old geologic reports (many one-of-a-kind reports) that are used by DGGS staff and visitors to research the geology of Alaska.
- IT milestones: Rewired server room. Provided IT support for projects and ensured that all networked systems were working optimally, 24/7, so that DGGS staff has the technical resources to carry out their duties efficiently. Ensured that all servers and desktops are backed up at least once per week and backup data is able to restore any lost or corrupted files.
- Ordered, formatted, and completed custom software setup on about 20 new desktop and laptop computers acquired to replace aging and non-fixable machines. Provided troubleshooting and repair for many other instances of hardware and software failures. Performed total system reinstalls on about eight computers and worked on about 20 others to eliminate problems related to speed (lack of it) or error messages.

GEOLOGIC MATERIALS CENTER

- Hosted 501 visits by industry, government, and academic personnel to examine rock samples and processed materials, down 10 from last year's record-breaking 511 visits. Collaboration from these visits helped acquire 319 processed slides, oil and gas samples representing 716,980 feet from 88 wells, and hard-rock mineral core representing 7,696.5 feet from three mining prospects, and publish 17 new laboratory data reports (http://www.dggs.alaska.gov/gmc-data-reports) derived from third-party analyses.
- Completed cataloging 99.5 percent of the entire oil and gas collection and 95 percent of the hard-rock mineral core into a working bar-code/database system. This massive effort will make the future transition to a new repository much more manageable, improve the quality of the collection data, and pave the way for a future, web interface used to query the available materials at the GMC.
- Performed quality control on the GMC's entire 30-year archive of 400+ GMC data reports. Many of these reports are produced by third-party analyses of samples at the GMC. Although the reports have not undergone technical peer review, the information and data are extremely useful and can aid in decision-making during the exploration process, reduce the loss of sample material from the GMC archive, and play a large role in re-analysis projects.
- Served 2,896 downloads of the GMC online inventory (http://www.dggs.alaska.gov/gmc/inventory.php), which was released to the public in April 2010. Since the release, the inventory files have been downloaded 8,327 times. This dataset, available in Google Earth and PDF formats, includes oil and gas well locations, mineral prospect locations, sample types, and box-level details for over 85 percent of the materials inventory available at the GMC. The online inventory allows users to quickly and easily view details of the GMC's materials repository before visiting the facility.
- Contract curator and former Alaska State Geologist Don Hartman completed a major curation project involving invaluable NPR-A core samples from the USGS collection that were at risk of substantial data loss and potential damage from transporting the samples. As a result, 1,187 three-foot core sections, representing 22 oil and gas wells were examined for quality control, re-boxed, bar-coded, and indexed in the GMC database.
- Improved the usability and size of the GMC's core viewing area. An additional core viewing area has been added in the main warehouse with proper viewing tables and improved lighting to better accommodate users who wish to view and photograph samples. A private sample viewing area is also now available in a 20-ft section of a heated, mobile office trailer.

KEY ISSUES FOR FY2013–2014

NATURAL RESOURCE DEVELOPMENT

- Increased activity in the natural resource exploration and development industries is good for the state on many fronts. With an increase in activity comes an expectation that the state will provide the necessary geologic and geophysical data to facilitate that development. DGGS welcomes this challenge and will be doing everything possible to meet the needs of this renewed focus.
- Our effort to provide geologic data to these resource exploration and development industries will be tested as more and more end-users of our products demand quicker and more comprehensive response. The main challenge will arise from a static division personnel count and our inability to meet the rapidly changing needs of the resource development community with the current number of personnel. An additional key challenge will be to continue gathering required new field information in the face of rising operating costs.
- Numerous areas in the state have world class minerals and energy resource potential. Consequently, development of those resources is a key component to both local and statewide economic health. DGGS will be challenged to maintain constant data acquisition and timely publication of results in multiple areas of the state, addressing multiple types of geologically hosted resource.

- There is growing national awareness and concern related to critical and strategic minerals supply. The United States now imports 100 percent of 20 key mineral commodities and more than 50 percent of an additional 24. Many of these elements are included on a list of strategic and critical minerals maintained by the USGS, many of which are considered to be critical to national security. Alaska has historical production of 13 of these imported minerals, and potential for production of all but two of the 44 minerals that are imported at greater than 50 percent. DGGS will be challenged to provide sufficient new data and interpretations on the occurrence of these minerals deposits for industry and land managers.
- Both the North Slope and Cook Inlet regions of the state are mature hydrocarbon producing regions. Like all mature hydrocarbon basins, the 'easy' prospects have been drilled and tested and what remains are plays that require significant investment to reach discovery and production. One of the key links in that investment chain is the acquisition of new geologic data using modern technology. DGGS will continue to be challenged to provide new information on petroleum systems that will lead to new discoveries.
- Spikes in the exploration cycle also create a situation where high-paying, private-sector jobs become abundant, and opportunities for experienced geoscientists become commonplace. The State must remain diligent in order to remain competitive in recruitment and keep our best and brightest employees.
- DGGS must continue developing and optimizing its data acquisition programs and work to discover new and more efficient ways to disseminate the information to the groups that need it.

INFRASTRUCTURE PROJECTS AND PUBLIC SAFETY

- Development of Alaska's vast resource base requires access to world markets. Providing geologic data for infrastructure maintenance and development will remain a key challenge for DGGS.
- Large projects to develop Alaska's huge natural-resource base and sustain the state's economy require baseline data and hazards analysis to enable permitting to be completed in a reasonable timeframe and the environment to be properly protected. Unfortunately, most areas have only minimal data, and little of the detailed geologic mapping that will be necessary to undertake these activities.
- Continued arctic warming will undoubtedly increase maintenance requirements on many of Alaska's current roads and transportation corridors. Identifying geologic hazards and areas prone to failure will be necessary to mitigate this change. Increased materials requirements will likewise strain Department of Transportation & Public Facilities' (DOT&PF) ability to address this issue. DGGS will work with other state agencies to provide modern analytical techniques for this work.
- Population continues to expand in some areas of the state, and many of those regions have essentially no baseline data on which to base zoning efforts and restrictions. Likewise, many areas where resource development is expanding lack the most rudimentary baseline data on things such as groundwater, geologic hazards, and resource abundance.
- DGGS will be challenged to provide geologic information for infrastructure, residential, and economic development, as well as for transitioning from our hydrocarbon-based economy. All construction in the state requires a complete analysis of the inherent geologic risks that are commonplace but poorly understood in most areas of Alaska.

CHANGES IN LOCAL ENERGY SUPPLY AND CONSUMPTION

- A complete, or even partial, retooling of the state's domestic energy supply is not a trivial exercise. Providing the investment necessary to make changes is a first important step; however, there must also be oversight and monitoring of projects to avoid the substantial mistakes of the past. The Alaska Energy Authority has completed the first six rounds of the renewable energy grant program, which is working to develop alternate forms of energy in all corners of the state. DGGS will continue to be closely involved in reviewing the proposals for resource and hazards potential, methodology, and data accuracy. DNR will be tasked with the substantial job of regulating and permitting the hundreds of projects that have the real potential to significantly impact the state's natural resources.
- Sustained high energy prices and the current push to curtail carbon-based fuel use could have 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 about potential alternate forms of energy such as shallow natural gas, coal, geothermal, and conventional gas. The cost associated with developing these alternatives is often prohibitive on a small scale, but in some cases will be necessary to replace even higher cost diesel fuel. Helping local governments grapple with increasing energy costs will remain a key challenge.
- Misinformation about viable alternative energy sources is rampant and many expensive mistakes can be avoided by getting accurate information in the hands of the local governments and decision makers.
- DGGS will be challenged to provide pertinent and timely data on numerous fronts, and address the occurrence of locally available energy sources. DGGS will continue to strive to make data available to those that need it, moving Alaska toward a more secure energy future.

RESPONSE TO DATA NEEDS FOR ADAPTATION TO A CHANGING ARCTIC CLIMATE

- Over the coming years, Alaska will be a national focal point for indications and impacts of climate change. DGGS's 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 mitigation. We will continue to collect geologic and hazards data needed to help mitigate risks and adapt to the changing environment, and make that data available to the public.

- Geologic information will be needed in a number of key climate-related mitigation efforts. Most importantly, these data will be required in areas of coastal development and critical infrastructure where ground settlement from thawing permafrost, 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 up-to-date regional baseline data be gathered and made available. Continued population growth and development in Alaska will continue to encroach on areas with heightened geohazard risk.
- Because of the nearly ubiquitous need for modern geologic mapping in impacted areas of the state, DGGS will be tasked with acquiring geologic data, producing maps, and identifying risks (information that can be used in both short-term and long-term planning). In some cases it will be critical to have these data available in crisis situations.
- DGGS will work with numerous agencies (with a wide range of mandates) in a coordinated effort so that the most important needs are addressed, and redundancy is minimized.
- A key challenge will be in the prioritization of study areas because there is much more need for data than there are personnel and funding to acquire it.

UPDATING AND IMPROVING THE ALASKA GEOLOGIC MATERIALS CENTER

- Our ability to develop the state's natural resources and maintain a robust economic engine is continually challenged on many fronts. Significant investment in infrastructure will be required in the coming years to advance exploration and development efforts statewide. The Geologic Materials Center (GMC) is a key part of that resource infrastructure and is the "first stop" for oil and gas and mineral exploration companies that are attempting to prospect in the complex geology of Alaska.
- The GMC facility archives samples and rock core representing more than 13 million feet of drilled core and samples from 1,600 oil and gas exploration and development wells; 300,000 feet of mineral core wells, and irreplaceable samples from geologic research performed and mapping completed for every corner of the state.
- Although the GMC is being adequately maintained in its current condition, the facility is filled to more than 70 percent above its maximum sample-storage capacity, and is very poorly designed to handle the frequent requests for reasonable access to the material.
- The GMC currently utilizes 60 portable shipping containers as storage facilities for newer sample acquisitions. These 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.
- Providing efficient and comprehensive access to these data is critically important for viable exploration programs, for both seasoned Alaska exploration companies and new companies that are trying to identify potential exploration areas.
- The current core and sample observation area is 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 result in reluctance by some companies to make use of the facility because they must go through the onerous effort of transporting and unnecessarily handling the material at risk.
- The Governor's FY2014 budget includes a capital appropriation to begin the process of replacing the aging facility. A key challenge will be to provide sufficient information to the public, lawmakers, and government officials regarding the importance of upgrading this facility and approving the funding necessary to keep this data source safe and accessible. One piece of core from this archive has the capability to identify a resource prospect that will bring billions of dollars to the state. It is imperative that Alaskans be aware of this fact so they understand that investment in the GMC upgrade is an investment in future revenue generation.

DGGS FY2013 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 Alaska State Legislature, the federal Congressional delegation, professionals in the private sector, academia, and individual Alaskans. 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 FY2013 DGGS program focuses on projects designed to foster the creation of future Alaska natural-resource jobs and revenue and to mitigate adverse effects of geologic hazards. For the foreseeable future, much of the state's economy will

continue to depend on developing the 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 land-use, 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, civil engineers, air carriers, other DNR agencies, Department of Commerce, Community & Economic Development, Department of Transportation & Public Facilities, Division of Homeland Security & Emergency Management, U.S. Geological Survey, and the Federal Emergency Management Agency. DGGS geologists provide geological and geophysical information to assist mineral prospectors, 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 geologic samples collected by private companies and government agencies.

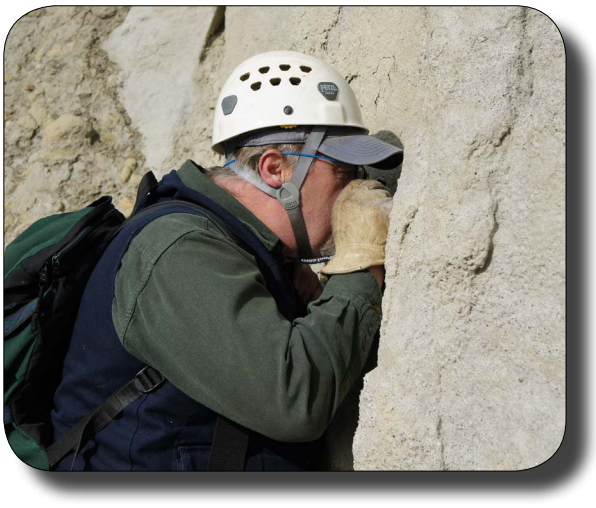
FY 2013 DIVISION EXPENSE BUDGET
(estimated expenses in thousands of dollars)

Program	General Fund	CIP	Federal	Interagency & Program Receipts	Total
Energy Resources	822.9	812.1	159.0	90.7	1,884.7
Mineral Resources	1,564.0	2,396.8	22.4	19.0	4,002.2
Engineering Geology	516.5	650.4	379.0	692.2	2,238.1
Volcanology	0.0	0.0	1,027.8	0.0	1,027.8
Geologic Communications	1,053.6	0.0	0.0	10.0	1,063.6
Geologic Materials Center	324.0	237.0	0.0	50.0	611.0
Administrative Services	458.0	200.0	0.0	0.0	658.0
Seismic Hazards Safety Commission	10.0	0.0	0.0	0.0	10.0
Total by funding source	**4,749.0**	**4,296.3**	**1,588.2**	**861.9**	**11,495.4**

PROGRAM SUMMARIES

STATE GEOLOGIST/DIRECTOR

The Director's Office provides leadership and coordination for the activities of the Division through the State Geologist/Director, Division Operations Manager, 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 Congressional 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. With the continued decline in the state's conventional oil reserves on the North Slope and the potential for natural gas shortfalls in southcentral Alaska, it has become exceedingly important that new energy resources are identified in the state to help offset declining conventional reserves and state income. An additional short-term need that must be addressed 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 fields. 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 2012, DGGS compiled recent field mapping in the Umiat-Gubik area and began integrating this surface data with available subsurface information. We also initiated a collaborative project with the U.S. Geological Survey and the University of Alaska Fairbanks to evaluate the geology of potential shale oil units on the North Slope. Initial field work during the summer of 2012 focused on the stratigraphy and geochemistry of the prolific oil-prone Shublik Formation exposed in the eastern Brooks Range foothills.

Exploration for gas within the Cook Inlet basin continues to be of high interest for the oil and gas industry due to potential deliverability shortfalls in the southcentral Alaska gas market. Additionally, over the last few years several companies new to Alaska have expressed significant interest in exploring the basin's oil potential. This new interest is focusing attention on undiscovered conventional oil and gas reservoirs and the possibility of unconventional reservoirs (such as tight gas sands, fractured reservoirs, and source-reservoired oil and gas). To stimulate sustained exploration interest, DGGS initiated a multi-year study of this basin in 2007, providing relevant high-quality data to help evaluate resource potential of the basin. 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 summer 2012 DGGS resumed stratigraphic and structural studies along the western margin of lower Cook Inlet in the Iniskin and Tuxedni bay areas, along with new locations on the upper Alaska Peninsula. Strata in these areas represent the Mesozoic oil source rocks for the Cook Inlet petroleum system and potential reservoir rocks that remain virtually unexplored underlying currently producing areas of the basin.

There are many sedimentary basins in Alaska whose geologic characteristics are conducive to natural gas, including unconventional gas. However, most of these basins are so poorly known that we do not have a realistic understanding of their gas potential. For example, the geology of the Susitna and Nenana basins suggests they could host natural gas in quantities that could be exploited for in-state use. In 2011 DGGS initiated a multi-year study of the natural gas potential of interior basins, beginning with stratigraphic studies in the Susitna basin. Field studies resumed in 2012 in the vicinity of the Nenana basin, where interest in exploration for natural gas has increased in recent years. Information obtained from this work will add to the database of publicly available information on the petroleum geology of these basins, which will help stimulate private-sector exploration activity.

There has been an increased interest in Alaska coal for export, for conventional power production, metallurgical uses, as well as for possible underground coal gasification to help meet southcentral Alaska's energy needs. The Statewide Energy Resource Assessment program has published information on Alaska's coal basins, evaluated coal lease applications, and continues to collect new coal-quality and stratigraphic data. As part of an integrated DGGS geologic data management system, the Energy Resources Section is continuing to build its comprehensive statewide coal resource data files and creating a new GIS-based coal resources map of Alaska.

As part of a multi-year, federally-funded program to build a comprehensive database for geothermal information in all 50 states, the Statewide Energy Resource Assessment program continued its efforts in 2012 and developed a new list of Alaska thermal springs and associated aqueous and gas chemistry. Data are being compiled for a new geothermal map for Alaska that will also include Quaternary and younger volcanic vents along with active faults.

The Statewide Energy Resource Assessment team completed its efforts of final write-ups and creating maps and figures toward publication in September 2012 of a special report, *Fossil fuel and geothermal energy sources for local use in Alaska: Summary of available information*. This work summarizes available relevant information and identifies areas of the state where additional information is needed to better understand the true resource potential for local energy uses. This information will ultimately be incorporated into the web-based interactive map currently hosted by the Alaska Energy Authority.

The numerous elements of the Statewide Energy Resource Assessment program are financed from a mixture of 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 outside the Prudhoe Bay–Kuparuk field areas.
2. Collect and publish new geologic data to stimulate renewed, successful exploration for hydrocarbons in the Cook Inlet basin.
3. Collect and publish new geologic data to stimulate exploration for natural gas in the Susitna and Nenana basins.
4. Collect new data and compile legacy published and unpublished geothermal data for Alaska to be incorporated into a new geothermal map of Alaska that will provide the industry and state agencies with accurate and current data in a comprehensive geothermal information database for Alaska.
5. 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.

FY2013 ENERGY RESOURCES PROJECTS

Detailed project summaries for the following energy resources projects appear in the section *Project Summaries—FY2013*:

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 & Water.
- Respond to requests from other state agencies, federal agencies, industry, local government, and the public for information on energy-related geologic framework and oil, gas, coal, and geothermal resource data.

MINERAL RESOURCES

The minerals industry has been a significant and steadfast partner in the economic well-being of Alaska since the late 1800s. In more recent times, global demand for precious, base-metal, and strategic minerals is at an all-time high and Alaska's mineral reserves will play a significant role in helping to meet that rising demand. The minerals industry, however, has historically been reluctant to commit significant company resources to exploration anywhere without sufficient understanding of the geologic framework of their areas of interest. To attract exploration interest 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. Since the early 1990s, a DNR/DGGS program of integrated geological and geophysical mapping has been effective in attracting new private-sector mineral investment capital to Alaska. Projects conducted by the Mineral Resources Section are designed to produce, on a prioritized schedule, the critical new geophysical surveys, geologic maps, and reports needed to sustain Alaska's mineral industry investments and provide management agencies with information needed to formulate rational management policy.

A significant recent addition to the DGGS Mineral Resources program, initiated by the Governor and Legislature with Capital Improvement Project funding, is the Strategic and Critical Minerals Assessment Program. The intent of this multi-year project is to determine Alaska's geologic potential for rare-earth elements and other minerals that are essential for our modern, technology-based society, including military and high-technology applications, and clean/renewable-energy applications such as wind turbines, solar panels, and batteries for

electric vehicles, among many other uses for which the U.S. is overly dependent on foreign sources for the required minerals. This project began in FY2012 with a survey and compilation of existing data on rare-earth element occurrences in the state and expanded significantly in FY2013 to include additional critical minerals, conduct re-analyses of existing samples, and obtain new field and analytical data, including airborne geophysics.

The numerous elements of the Mineral Resources Section are financed from a mixture of sources: general fund base budget, Capital Improvement Project funding, and Federal receipts.

OBJECTIVES

1. Catalyze increased mineral resource exploration in Alaska.
2. Provide DNR, other state agencies, and the public with unbiased, authoritative information on the geologic framework and mineral resources of the state, to support rational land-policy and investment decisions.
3. Provide, in cooperation with the Department of Commerce, Community & Economic Development, accurate annual statistical and descriptive summaries of the status of Alaska's mineral industry.

FY2013 MINERAL RESOURCES PROJECTS

Detailed project summaries for the following Mineral Resources projects appear in the section *Project Summaries—FY2013*:

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 and federal agencies, local government, industry, and the general public.
- Provide authoritative briefings about the status of Alaska's mineral industry, state support for mineral-resource 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-hazards 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 and interagency receipts.

In many 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 hazards 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 hazards 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 Canada border. The purpose of this multi-year project is to provide detailed geologic information for a 12-mile-wide 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. Fieldwork was largely complete by 2010, with a minor amount of additional field assessment in 2011 and 2012 and final reports and maps to be published in 2012 and 2013. Work on this project is expanding to include the assessment of surficial geology and geologic hazards along alternative gas pipeline routes. With federal and state support, DGGS contracted for high-resolution lidar (Light Detection and Ranging) surveys of all the proposed gas pipeline corridors in 2010-2011. Analyses of these data are providing significant new insights into the surficial geology and hazards evaluations that will be incorporated into the final reports.

Major projects have been developed in response to the overwhelming need for baseline geologic mapping and natural hazards evaluations in and near communities and important infrastructure that are being affected by severe problems. Funded by the federal Coastal Impact Assistance Program, the DGGS Coastal Hazards Program is undertaking an ambitious 5-year mission to evaluate surficial geology and geologic hazards in up to 19 Alaskan coastal communities that are at risk for serious storm-wave erosion and flooding. 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. The Climate Change Hazards Program performs geologic studies to identify high-risk areas where proactive mitigation efforts will be needed and useful for minimizing possible impacts. In 2012, the program's expertise was called upon to present on the hazards of glaciers in a changing climate at the U.S. Embassy and Office of Naval Research in Santiago, Chile. Additionally, division expertise in the field of neotectonics (active faulting) is dedicated to identifying and understanding active faults and earthquake hazards in developing areas of the state. The Active Faulting/Earthquake Hazards Program is engaged in significant

work in support of proposed infrastructure projects and makes major contributions to community tsunami hazards studies and collaborative projects with the U.S. Geological Survey and university researchers from across the country to study and understand the fault-related hazards in Alaska.

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.

FY2013 ENGINEERING GEOLOGY PROJECTS

Detailed project summaries for the following Engineering Geology projects appear in the section *Project Summaries—FY2013*:

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, and other proposed development projects, and respond to verbal requests for information from other state agencies, local government, and the general public.
- When appropriate, conduct post-event hazard evaluations in response to unexpected major geologic events (e.g., earthquakes and severe coastal flooding and erosion), 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 is part of the Alaska Volcano Observatory (AVO), an interagency consortium that monitors, evaluates, and mitigates hazards from Alaska volcanoes. AVO was formed by Memorandum of Understanding in 1988. Its partners are DGGS, the U.S. Geological Survey (USGS), and the University of Alaska Fairbanks Geophysical Institute (UAF/GI), and funding comes principally through the USGS. The Director of DGGS established Volcanology as a separate section in early 2007.

AVO studies volcanoes to increase understanding of hazards at particular volcanoes and volcanic processes 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. The majority of Alaska's 52 historically active 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 reports. The vulnerability of local infrastructure to active volcanoes was illustrated by the near flooding of the Drift River Oil Terminal on the west side of Cook Inlet by lahars (volcanic mudflows) generated on three separate occasions during the spring 2009 eruption of Redoubt Volcano. In addition, important transportation hubs at Cold Bay, Unalaska/Dutch Harbor, and Adak are all downwind from nearby active volcanoes, and a new 4,500-foot airstrip 15 miles downwind from Akutan Volcano was opened in September 2012.

The three component agencies of AVO each bring particular strengths to the observatory, while sharing general expertise in volcanology. Among these agencies, DGGS has particular strengths in web outreach, geologic studies, and petrologic and geochemical studies. DGGS builds and maintains 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 have emerged as the most powerful such tool among volcano observatories worldwide, and portions of the software designed and written at DGGS are in use at other volcano observatories, both nationally and internationally. Particular strengths of the USGS are the federal hazards mandate and direct ties with federal agencies. UAF/GI brings a research focus and access to technological resources (such as satellite data downlink centers) beyond the financial capability of other AVO partners. All agencies have fundamental expertise in the many scientific and technical disciplines that comprise volcanology.

Funds for DGGS participation in AVO come from cooperative agreements with the USGS through the USGS Volcano Hazards Program. In the past, additional funding has come through congressionally authorized programs in other departments, including Transportation (DOT) and Defense (DOD), as well as the American Reinvestment and Recovery Act (ARRA).

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 in the multi-agency 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.

FY2013 VOLCANOLOGY PROJECTS

Detailed project summaries for the following Volcanology projects appear in the section *Project Summaries—FY2013:*

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 about 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 crises.
- 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. DGGS is currently leading the effort in AVO to make a web-accessible catalogue of GIS resources.
- Provide helicopter and fixed-wing airplane logistics. DGGS manages helicopter charter procurement for all major AVO projects, 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. The data share rigid inter-project quality controls, making the combined dataset 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.
- Provide information on geothermal resources to state and federal agencies, the private sector, and the public.

GEOLOGIC COMMUNICATIONS

The Geologic Communications Section provides information technology, publication, and outreach services to make Alaska geologic and earth science information accessible to the public, private industry, government, and academia. 'GeoComm' team members work together to complete final design and production of reports and maps, maintain and upgrade the division's Digital Geologic Database, update and improve the DGGS website, and ensure the entire division has the infrastructure (GIS tools, network, computer equipment, etc.) and skills necessary to efficiently perform their responsibilities.

The section's publications specialists edit, complete the layout, publish, and distribute technical and summary reports and maps generated by the Division's technical projects describing Alaska's geologic resources and hazards. The maps and reports released with the help of this group are the state's primary means for widely disseminating detailed information and data relating to Alaska's subsurface mineral and energy wealth, geologic construction materials, and geologic hazards. These printed or digital-format documents and datasets focus on Alaska's most geologically prospective and developable 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 and job opportunities. Timely availability of geologic information from DGGS encourages investment in Alaska's economy, helps foster wise land-use management, and helps mitigate the adverse effects of geologic hazards.

The section's geologic information center ensures that information produced by the division is delivered to the public on a wide range of topics, including mineral and energy resources, construction materials, earthquakes, volcanoes, permafrost, and other hazards. It assists customers in understanding geological and geophysical maps, and manages sales and inventories of geologic reports, maps, and digital data. Additionally, the information center prepares displays and represents the division at geologic conferences and events.

The Geologic Communications Section produces this annual report, which presents a summary of division activities and accomplishments; publishes newsletters to communicate division progress and announce recent publications; designs, edits, and produces technical and educational geologic maps and reports in printed and digital formats; manages the DGGS library/repository of printed literature so that reports (by DGGS and other agencies) are available as resources for geologic staff use; and participates in outreach activities such as classroom presentations, science fair judging, and providing resources for teachers to help with preparing earth science learning units.

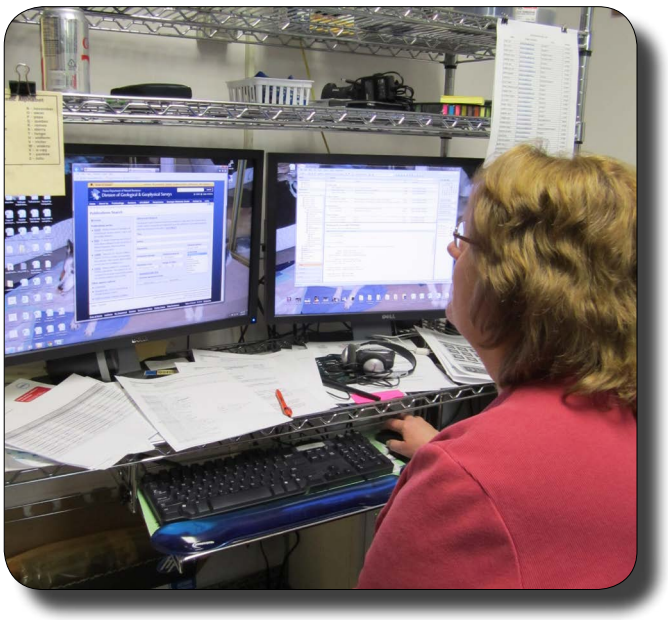
DGGS's digital geologic database (Geologic & Earth Resources Information Library of Alaska [GERILA]) has three primary objectives: (1) Maintain this spatially referenced geologic database system in a centralized data and information architecture with networked data access for new DGGS geologic data; (2) create a functional, map-based, online system that allows the public to find and identify the type and geographic locations of geologic data available from DGGS and then retrieve and view or download the selected data along with national-standard metadata (http://www.dggs.alaska.gov/pubs/); and (3) integrate DGGS data with data from other, related geoscience agencies through a multi-agency web portal (http://www.akgeology.info/).

The Geologic Communications Section sets up and maintains microcomputer and server hardware and software, supports the division's local area network, provides Geographic Information System (GIS) service and training to DGGS staff, and streamlines information delivery to the public. The section developed the division's website and began extensive use of the Internet in FY98 to increase the availability of the Division's information and to provide worldwide access to information about the geology of Alaska. 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 provided several years of support for an extensive effort to scan, convert to digital format, and post the entire hardcopy DGGS collection of publications on our website. The U.S. Geological Survey (USGS) provided additional funds to do the same for all pre-digital Alaska-related USGS publications and make them available via the DGGS website. Recent additions to the DGGS website include the Alaska minerals-related publications of the former U.S. Bureau of Mines, additional USGS publications, and publications produced by the University of Alaska Fairbanks, Mineral Industry Research Laboratory (MIRL).

The Geologic Communications Section is supported by the State general fund, program receipts from publication sales, and Federal receipts.

OBJECTIVES

1. Disseminate new, accurate, unbiased, Division-generated data describing Alaska's geology, as well as selected pertinent data from other sources, to DNR and other State policy and regulatory groups, to the public at large, 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 and documented with national-standard metadata.
3. Enhance public awareness of Alaska's prospective mineral and energy resources and geologic hazards.



FY2013 GEOLOGIC COMMUNICATIONS PROJECTS

Detailed project summaries for the following Geologic Communications projects appear in the section *Project Summaries—FY2013*:

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 analyzed by government and private-sector geoscientists with the goal of improving 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 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 GMC holdings are a continually growing asset that is compounding in value over time at little cost to the state. Three Division geologists, a contract geologist, two student interns, and several volunteers staff the facility. The GMC has formal cooperative agreements with the U.S. Geological Survey, the U.S. Bureau of Ocean Energy Management, and U.S. Bureau of Land Management to house and control their geologic materials from Alaska. A volunteer 14-member board advises the curator and DGGS on matters pertaining to the GMC.

With federal funding and through a Reimbursable Services Agreement with the Department of Transportation & Public Facilities (DOTPF), DGGS completed a concept study in 2006 for construction of a new materials center to replace the existing GMC. The 2006 concept study report is available on the GMC web page (http://dggs.alaska.gov/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. The state has begun design and engineering work for a new facility through a project managed by the Department of Administration (DOA) with support of Capital Improvement Project (CIP) funds and GMC staff has drafted an inventory transfer plan.

Please see a more detailed briefing summary for the GMC on page 69.

OBJECTIVES

1. Encourage responsible resource development and in-state employment opportunities by increasing accessibility to representative geologic samples and information pertaining to 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.

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; coordinating maintenance for state equipment fleet vehicles, and when necessary, procuring vehicles for fieldwork; 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; providing mail/courier services; providing assistance in personnel matters; and any other support necessary to increase 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, CIP, and program receipts) to ensure deliverables are produced on schedule and within budget; ensure expenses are timely and properly billed against grants and contracts and receipts are collected promptly; ensure progress reports and financial paperwork are submitted accurately and on time.

- Provide accurate, timely reporting of project expenditures and current balances to project managers; encourage prudent money management.
- Provide accurate, timely processing of employee timesheets, vendor 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 most cost-effective travel options.
- Assist staff with personnel matters; inform staff of 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

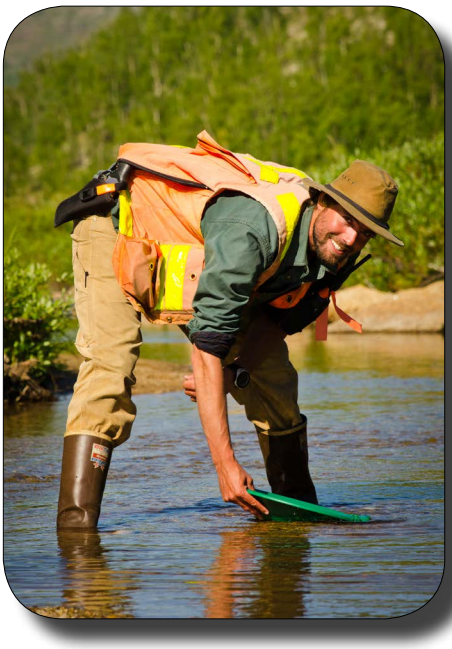
Gina Graham has returned to DGGS as a Geologist III, assisting the airborne geophysics program with data management and metadata development. Gina has a B.S. in Geology from UAF and has previously worked for the Alaska Volcano Observatory, DGGS, and Science Applications International Corporation, acquiring experience in geophysics, GIS, project management, data management, and business intelligence reporting along the way.

When not working, Gina and her husband Dan and their dogs are currently building a house with an off-the-grid electrical system on their property next to a runway. As the house gets completed, Gina will get back to tinkering in the garden and flying with Dan to see friends and family around Alaska.

Patricia (Trish) Gallagher joined DGGS in October 2012 in a permanent position as a Cartographer/GIS Technician. Trish grew up in the foothills of Colorado and moved to Alaska to attend the University of Alaska Fairbanks. She graduated in May 2009 with a bachelor's degree in geology.

After graduation, Trish worked with DGGS as a non-permanent geologist, where her primary responsibilities were to use GIS and graphics programs to edit maps as part of the Gas Pipeline Corridor Geologic Hazards and Mapping Project. Trish managed the project's field database and assisted with field logistics in addition to doing GIS and graphics work. Previous to her work on the pipeline corridor project, Trish supported multiple other DGGS projects with field operational support, computer and field data management and input, post-field sample management, data analysis, ArcGIS data-layer construction, and final cartographic design. Trish also organized logistics for the 2012 Friends of the Pleistocene (FOP) field trip along the Alaska Highway. She was awarded the honor of "Awesome Logistics Queen" by the FOP participants.

When not at work, Trish loves to bake, skijor, garden, ride horses, and run agility with her lovable husky, Aedan.



Geologist **Erik Bachmann** joined DGGS's Engineering Geology Section in March 2012 to assist in the compilation of historical geologic maps for the Susitna–Watana Hydroelectric Dam Project. In June the Mineral Resources Section asked Erik to draw on his mineral exploration experience and assist with the Strategic and Critical Minerals Assessment project in the Ray Mountains study area during the 2012 field season. He has since joined the Mineral Resources Section full time, performing various tasks, including database creation and maintenance, sample preparation, GIS data creation, and sample processing.

Born and raised in Fairbanks, Erik is familiar with the unique aspects of life in the Arctic. He earned his B.S. in Earth Science from Montana State University, Bozeman, in 2007 while also honing his outdoor skills as an avid backcountry skier and backpacker. After returning to Alaska he has participated in field programs with two mineral exploration companies. One project involved inspecting core from the proposed Livengood lode gold mine, and the other focused on helping to characterize and constrain a placer gold deposit on a paleoshoreline in Nome.

In his free time, Erik enjoys exploring the vast Alaska backcountry with his wife and two dogs. He is an avid photographer who enjoys spending as much time in the wilderness as he can, in some combination of backpacking, skiing, biking, sailing, rafting, and camping.

MORE THAN 25 YEARS

Paula Davis began her employment with DGGS in March 1987 as a Clerk Typist III. She moved down the hall shortly thereafter to work as Secretary for DGGS's then-newly-arrived Director, Bob Forbes, who chose to be stationed in Fairbanks rather than Anchorage. A couple years later, Paula was appointed to be the division's Administrative Assistant and spent most of her time helping with budget and expense tracking, and taking care of a multitude of associated minutiae. After a couple more years, she was hired into an Administrative Manager position, in charge of compiling, submitting, and administering the budget, tracking grants and contracts, and managing the details associated with running a division.

Paula's focus changed significantly in 1994, when she moved out of the administrative realm and into a Publications Specialist position and began editing DGGS's maps and publications. She has enjoyed the challenge of learning a totally foreign vocabulary (each geology sub-discipline has its own 'special' words so that's a LOT of unique words) and editing things she really doesn't fully understand. She has also been awed at the high level of scientific expertise in this little corner of Alaska—and the professionalism of the people with whom she's worked over the years.

Paula was privileged to spend 12 of her first 17 years of life as a missionary kid—six years in Nigeria, and then six more in the Philippines. This exposure to other cultures (and being an obvious minority in those countries) has proven invaluable; it has also increased her appreciation of the United States and its positive and negative aspects. She looks forward to lots of traveling after retirement someday. Other interests outside the office include baking breads and desserts, crocheting, quilting, sewing, beading, and other crafts, and being an active member of her church.

PROJECT SUMMARIES—FY2013

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 42 projects that DGGS is pursuing in FY2013 span the scope of our legislative mission statement.

Each of these projects is making a positive difference for Alaska. Many are implemented through various cooperative agreements with other state and federal agencies, universities, in-house project teams, and contracts. We leverage State general funds through these arrangements so that the Division's work provides the greatest possible benefit from the public's investment.

ENERGY RESOURCES

MINERAL RESOURCES

ENGINEERING GEOLOGY

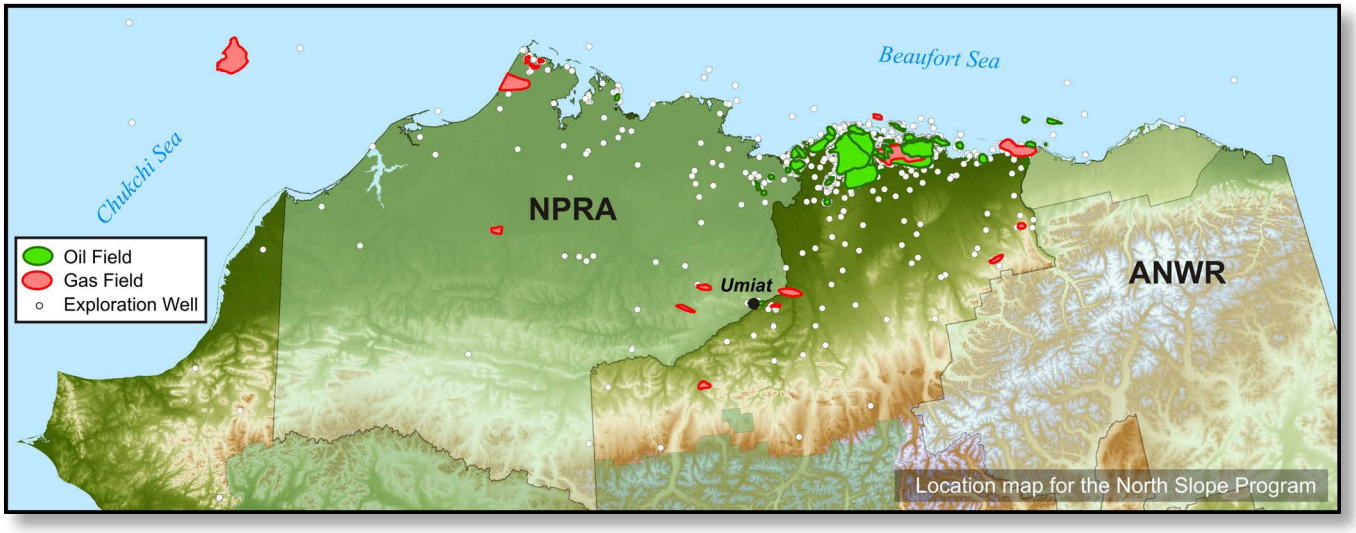
VOLCANOLOGY

GEOLOGIC COMMUNICATIONS

GEOLOGIC MATERIALS CENTER

BROOKS RANGE FOOTHILLS & NORTH SLOPE PROGRAM

Northern Alaska is a world class petroleum province that includes some of the most prospective onshore regions remaining in North America. Despite this potential, the North Slope remains underexplored relative to other sedimentary basins around the world. New exploration ventures are partially hampered by the limited amount of published geologic data, much of it reconnaissance in nature. This problem is particularly acute for smaller companies with limited access to proprietary industry data. In an effort to stimulate exploration for hydrocarbons in northern Alaska, the Division of Geological & Geophysical Surveys (DGGS) developed a program to acquire and publish high quality geologic data to improve our understanding of regional petroleum systems and entice new exploration investment. While directed by DGGS, this research effort is a multi-agency collaboration that includes the Alaska Division of Oil & Gas (ADOG), the United States Geological Survey (USGS), the University of Alaska Fairbanks, and others. Additionally, the oil & gas industry supports this program through contributions of funds and data.



During recent field seasons, our program conducted detailed geologic mapping and associated studies in the area of the proposed Umiat transportation corridor (see also page 29). Our work includes examination of the sedimentology and stratigraphy of key Cretaceous-age reservoir and source rock intervals, providing new constraints on the depositional history and correlation of strata. This type of detailed analysis of outcrop geology leads to improved models for where hydrocarbons will be most likely to accumulate in the subsurface.

Over the last several years we have collaborated closely with the Division of Oil & Gas to interpret available seismic and well data on the North Slope. The integration of our surface structural and stratigraphic observations with subsurface data has allowed for an improved understanding of basin evolution and regional exploration potential.

During 2012, DGGS also initiated a collaborative study with UAF and the USGS to evaluate the geology of prospective shale oil units. Exploration for this unconventional resource has only recently begun in northern Alaska. Although unproven, the world class source rocks in the region indicate this play has the potential to eventually add significant new petroleum production from the North Slope.

Two new 1:63,360-scale geologic maps will be published through DGGS early in 2013 (see page 29), as well as a collection of papers summarizing recent topical structural and stratigraphic studies. The limited exploration and development on the central North Slope partly reflects the region's remoteness and lack of infrastructure. This body of work directly impacts exploration in the area and compliments efforts of the State's Roads to Resources program.

DGGS geologist and "field assistant" conducting detailed stratigraphic studies at Umiat Mountain along the Colville River.

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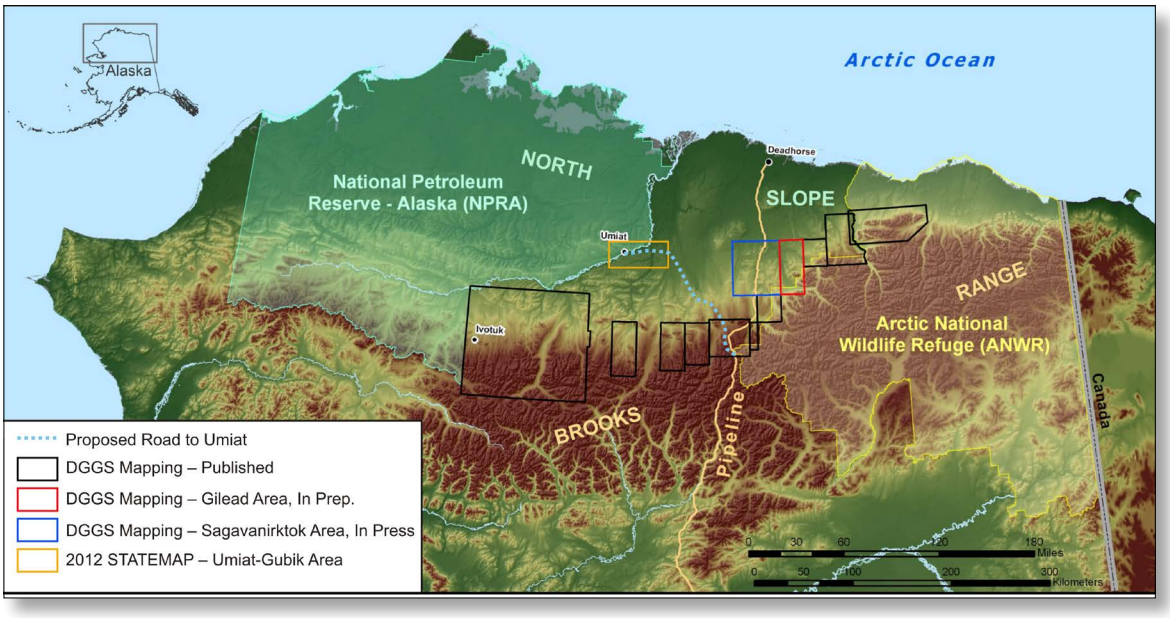
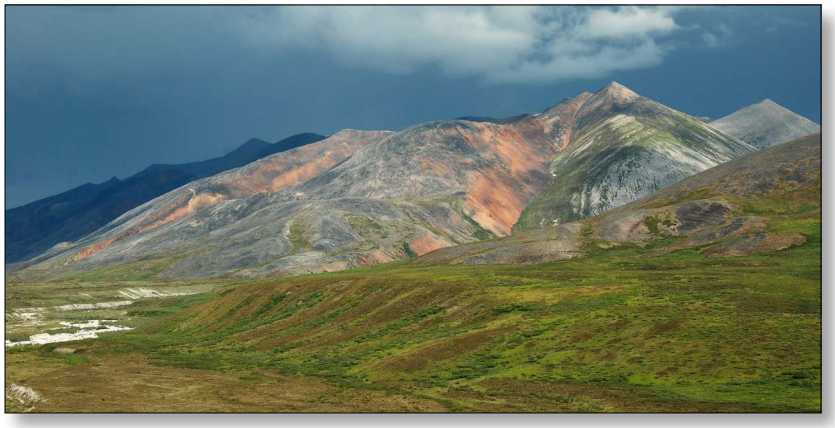
GEOLOGIC MAPPING ON THE NORTH SLOPE

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 offers 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 of the Division of Geological & Geophysical Surveys (DGGS) conducts bedrock geologic mapping as an integral component of the Brooks Range Foothills and North Slope Program (see also page 28). Our long range objective is to produce a series of contiguous detailed geologic maps along the entire foothills belt, thereby establishing the regional geologic framework necessary to understand the evolution of the petroleum system in support of resource management and industry exploration on State lands. The data generated from this work will directly impact efforts in conventional oil & gas exploration, as well as potential development of wide-spread unconventional resources like shale oil and gas, gas hydrates, and coal-related resources.



During recent summer field campaigns we completed detailed 1:63,360-scale geologic mapping of approximately 1800 square miles of the eastern North Slope (red and blue box on map). We have also conducted mapping in the Umiat-Gubik area (yellow box), a region whose recognized potential has led to a State proposal for construction of a major transportation corridor (blue dashed line on map). In collaboration with the Alaska Division of Oil & Gas, we have integrated our surface observations with available subsurface data (seismic and wells) to arrive at a more robust interpretation of the petroleum geology. The new mapping has improved our understanding of fold geometry, which is a key component in evaluating hydrocarbon trapping mechanisms. Detailed stratigraphic observations also enhanced our knowledge of how Upper Cretaceous rocks correlate with one another, allowing for improved models concerning the distribution of potential source and reservoir rocks in the subsurface.

This work was supported in part by the federally funded STATEMAP program administered by the U.S. Geological Survey (USGS). The Sagavanirktok River and Gilead Creek map products will be published by spring 2013—both as DGGS Reports of Investigation.



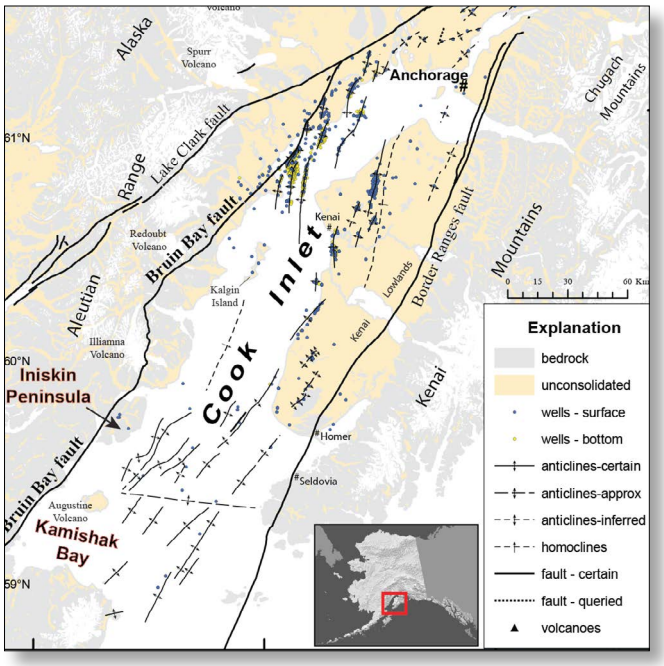
View of north-dipping stratigraphy at the Brooks Range mountain front in the Gilead area.

Contact, Sagavanirktok River map area: Robert J. Gillis, 907-451-5024, robert.gillis@alaska.gov
Contact, Gilead map area: Trystan M. Herriott, 907-451-5011, trystan.herriott@alaska.gov
Contact, Umiat-Gubik map area: Marwan A. Wartes, 907-451-5056, marwan.wartes@alaska.gov

COOK INLET GEOLOGY AND HYDROCARBON POTENTIAL

Increasing demand and predicted deliverability shortfalls for Cook Inlet gas supply to south-central Alaska customers, combined with significant oil production declines, pose potential threats to the region's economy. The Alaska Division of Geological & Geophysical Surveys (DGGS) is responding to these challenges by leading a multi-year, multi-agency program of applied geologic research to promote new exploration investment and support responsible resource and land-use management. This collaborative effort involves DGGS, the Alaska Division of Oil & Gas (DOG), the University of Alaska Fairbanks, and the U.S. Geological Survey.

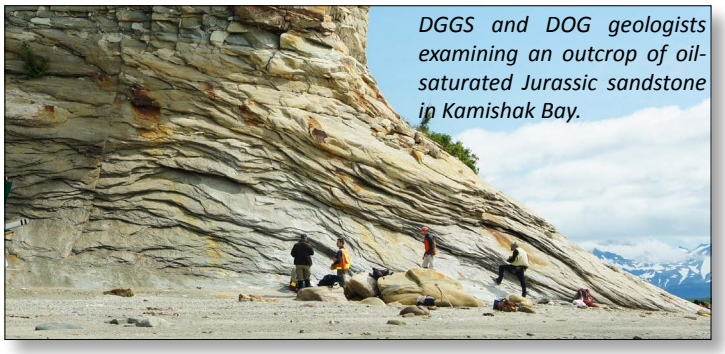
Historically, Cook Inlet exploration has focused on locating large fold structure reservoirs with four-way closure (analogous to an inverted bowl) in younger, shallower Cenozoic rocks. Most of these large, relatively shallow structures have been found and tested, but the older, deeper rocks that underlie the basin, and contain the source rocks for the Cook Inlet petroleum system, remain virtually unexplored. To incentivize exploration of pre-Cenozoic (Mesozoic) strata, the State Legislature in 2010 offered tax credits of up to 100 percent for the first three wells drilled by unaffiliated parties using a jack-up rig to test viable Mesozoic petroleum targets. DGGS and DOG during that period also began reconnaissance field studies of Mesozoic rocks in the lower Cook Inlet to improve understanding of reservoir types, reservoir quality, their geologic controls, and the structural history of the older parts of the basin.



Generalized geologic map of Cook Inlet basin. Modified from Haeussler and Saltus, 2011, U.S. Geological Survey Professional Paper 1776-D.

One of the challenges facing new exploration of the Mesozoic petroleum system in Cook Inlet is the identification of reservoir rocks capable of hosting oil and gas, because much of the pre-Cenozoic stratigraphy is commonly viewed as lacking sufficient porosity. During 2012, DGGS and DOG focused on developing a better understanding of the conventional and unconventional reservoir potential of Mesozoic rocks, and structural controls on Mesozoic depositional systems in the Kamishak Bay and Iniskin Peninsula areas in lower Cook Inlet (see map). Work in the Kamishak Bay area (see photo) focused on Jurassic and Cretaceous-age rocks, both of which contained intervals that are oil saturated, indicating that they had sufficient conventional permeability and porosity to pass and retain liquid hydrocarbons in the past. Samples collected at both locations will help to identify the hydrocarbon source rocks and determine whether the sandstone composition or other factors were responsible for their enhanced reservoir quality. Continued stratigraphic and structural studies in the Iniskin Peninsula area focused on how major geologic structures, such as the Bruin Bay fault (see map), influenced the stratigraphic architecture, which has implications for predicting the distribution of reservoirs and reservoir seal lithologies. We conducted fracture studies of Mesozoic rocks in the Kamishak Bay and Iniskin Peninsula areas to characterize the fractures with regard to rock type and proximity to faults and folds and to gather baseline data about non-conventional fracture porosity and hydrocarbon migration pathways.

Important additional components of this program include (1) a subsurface mapping effort aimed at delineating the distribution of petroleum source rocks relative to thick accumulations of potential reservoir sandstones; (2) structural analysis of basin bounding faults; (3) analysis of the subsidence and uplift history of upper Cook Inlet basin using publicly available well data; and (4) a detailed bedrock mapping project on the Iniskin Peninsula and nearby area (summer 2013 and 2014).



DGGS and DOG geologists examining an outcrop of oil-saturated Jurassic sandstone in Kamishak Bay.

This project is funded by the State of Alaska and the U.S. Geological Survey, with contributions from industry. Results of this work have been documented in a series of publications available from the DGGS website (http://www.dggs.alaska.gov). Additional publications will be released as they become available, beginning in early 2013.

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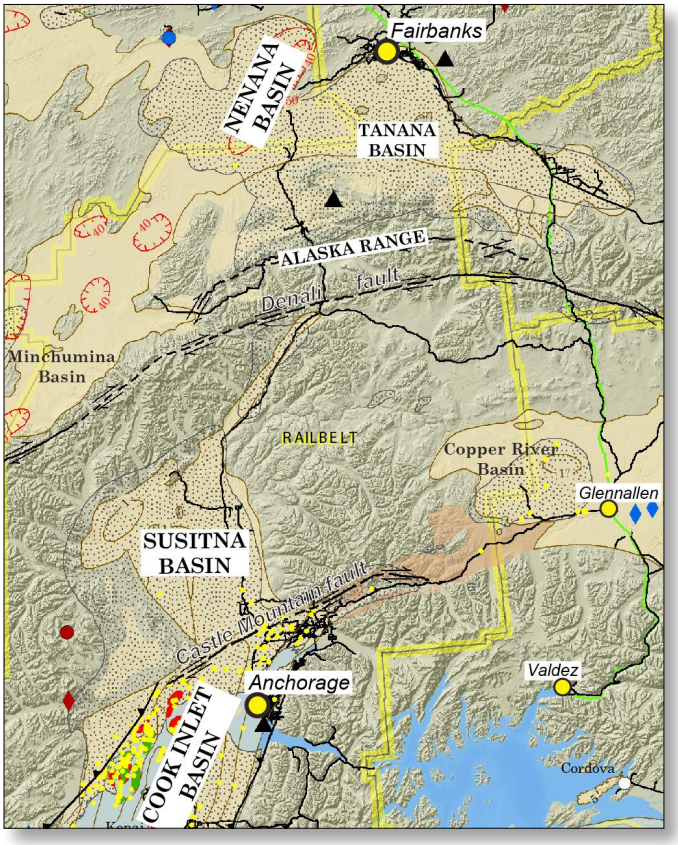
NATURAL GAS POTENTIAL OF THE SUSITNA AND NENANA BASINS

Alaska faces serious domestic energy challenges that place a significant percentage of the state's population, particularly in rural areas and interior regions, under heavy financial strain. This is because adequate energy sources at reasonable cost have not been identified to serve domestic needs over the next few decades. These challenges can be mitigated by looking for local sources of energy that have the potential to supply more affordable energy for local consumption.

The Alaska Division of Geological & Geophysical Surveys, in collaboration with the Alaska Division of Oil & Gas (DOG) and the U.S. Geological Survey, has responded to these challenges by reviewing publicly available data on sedimentary basins throughout Alaska to identify basins whose geology suggests significant natural gas potential (see http://www.dggs.alaska.gov/webpubs/dggs/sr/text/sr066.PDF). We have identified the Susitna and Nenana basins, on geological grounds, as having significant gas potential to help meet in-state needs. However, neither of these basins has been adequately explored, and little geologic data exists to help attract exploration interest. Basin analysis projects are underway in each basin aimed at better understanding the possible presence of functioning petroleum systems. This project is being conducted in three phases, with phase I focusing on the Susitna basin in summer 2011, phase II on the Nenana basin in spring 2012, and phase III on finalizing work in both basins and generating the final reports for each basin.



Map showing distribution of some interior sedimentary basins and their proximity to Anchorage and Fairbanks.

The Susitna basin (approximately 5,000 square miles) is thought to host some of the same gas-producing rocks as the neighboring Cook Inlet. During the 2011 field season, DGGS and DOG studied and described stratigraphic exposures at several locations within the basin and collected over 250 samples for various analyses related to evaluating petroleum system potential and geologic development of the region. The Nenana basin lacks exposures of potentially hydrocarbon-producing rocks at the surface for study, but the rocks in the subsurface are thought to be correlative to stratigraphy of similar age exposed in the foothills of the Alaska Range directly to the south. Similar to the Susitna basin, DGGS and DOG studied, described, and sampled selected stratigraphic intervals of these rocks at several locations during the spring of 2012. In addition, approximately 50 samples were collected from around the periphery of the Nenana and Tanana basins to develop a better understanding of how and when the basins began to form. DGGS and DOG will visit new locations of rocks related to the Susitna and Nenana basins to wrap-up our field studies of the basins in summer 2013 or 2014. Final reports will be released in 2015.

DGGS and DOG geologists examining coal-bearing strata of the Usibelli Group in Suntrana Creek near Healy.

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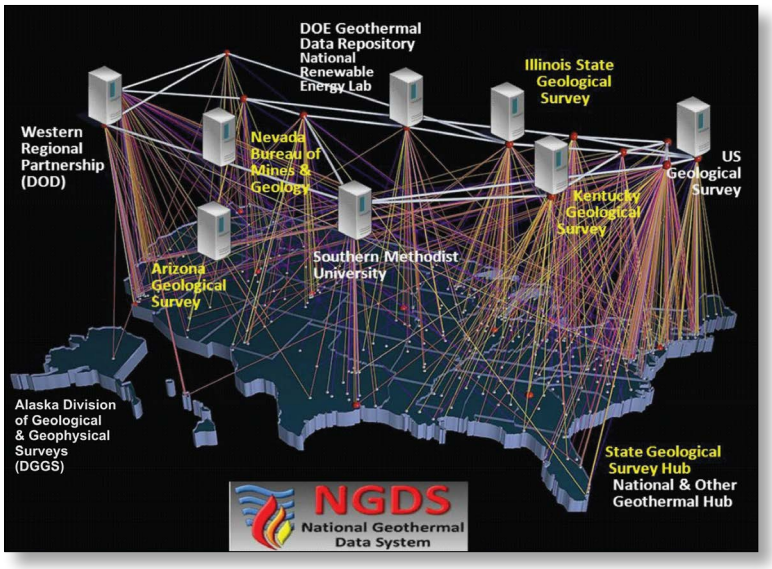
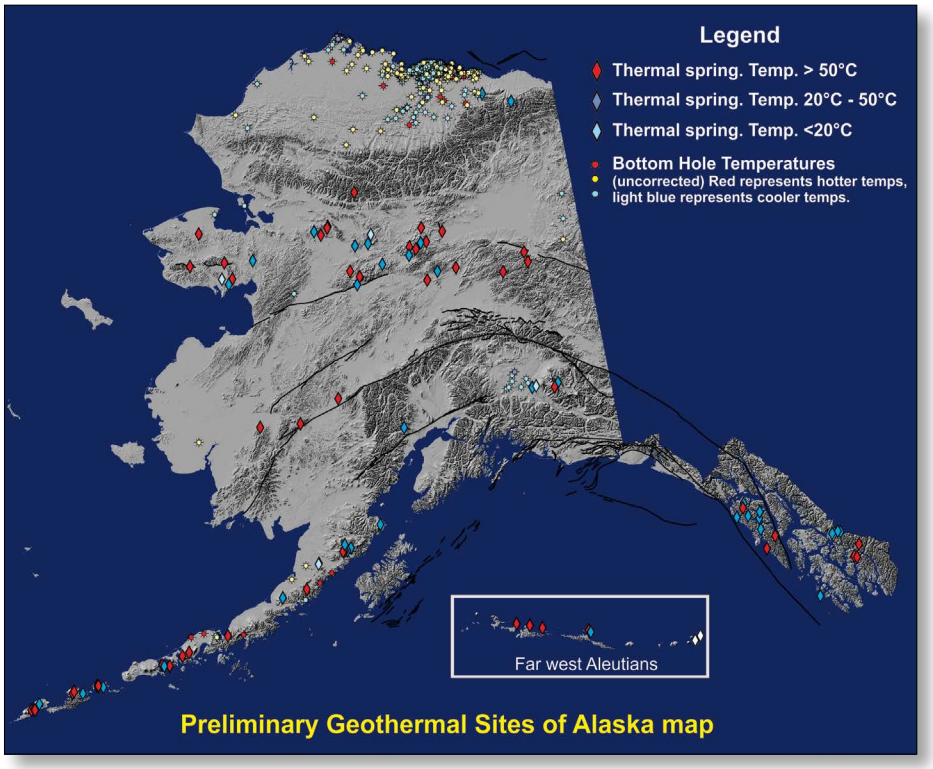
STATE OF ALASKA CONTRIBUTIONS TO THE NATIONAL GEOTHERMAL DATA SYSTEM

The National Geothermal Data System (NGDS) is a U.S. Department of Energy-funded distributed national network of databases and data sites that collectively form a system for the acquisition, management, and maintenance of geothermal and related data. The NGDS website is http://www.stategeothermaldata.org/. This national project, involving all 50 states, is organized by the Association of American State Geologists and administered by the Arizona Geological Survey. The goal of the NGDS is to make large quantities of geothermal-relevant geoscience data available to the public and industry by creating a national, sustainable, distributed, and interoperable network of data providers. The state geological surveys will develop, collect, serve, and maintain geothermal-relevant data as an integral component of NGDS. The project is digitizing at-risk, legacy geothermal-relevant data and publishing existing digital data by making state databases and directories available to the network.



50-state network of geothermal data providers to the NGDS and the regional hubs (in yellow).

Much of the risk of geothermal energy development is associated with exploring for, confirming and characterizing the available geothermal resources. The overriding purpose of the NGDS is to help mitigate this risk by serving as a central repository for geothermal and relevant related data as well as a link to distributed data sources. By helping with the process of assessing and categorizing the nation's geothermal resources, providing strategies and tools for financial risk assessment, and consolidating all geothermal data through a publicly accessible data system, the NGDS will support research, stimulate public interest, promote market acceptance and investment and, in turn, support the growth of the geothermal industry.



The Alaska Division of Geological & Geophysical Surveys (DGGS) is contributing Alaska geothermal data to the NGDS as part of a three-year national effort called the *State Geological Survey Contributions to NGDS Data Development, Collection and Maintenance*. The Arizona Geological Survey developed a series of geothermal feature templates for data to be included in the NGDS. During 2011 and 2012, DGGS submitted these feature templates to the NGDS: Alaska thermal springs, aqueous chemistry, volcanic vents, geothermal well-core descriptions (for Makushin and Akutan volcanoes), bottom hole temperature observations (for oil and gas wells), and Quaternary-active faults. In 2013, DGGS will complete this project by submitting feature templates on geothermal direct use and earthquake hypocenters around geothermal areas, and will complete a new comprehensive bibliography of Alaska geothermal information. The project will culminate in the completion of a new digital, ArcGIS-based "Geothermal Sites of Alaska Map" that will incorporate all of the related geothermal data sets submitted to the NGDS (see preliminary map above). This map will be available online for the public by spring of 2013.

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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 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 stratigraphic field data for previously described occurrences. Sometimes a coal occurrence described in 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.

We continue to submit coal samples collected from field crews conducting studies in both the Cook Inlet and North Slope coal provinces, for proximate and ultimate analyses. We focus only on thicker, potentially-mineable coal seams that have not been sampled previously. We are still in the process of acquiring Cook Inlet samples for CO_2 high pressure gas adsorption, with requests to industry to obtain samples from the North Slope and the Nenana basin also underway. The project continues to make progress rectifying for accuracy the legacy Alaska NCRDS data sent to DGGS by the USGS team.

The database for both the Alaska coal quality and stratigraphic information continues to grow and we are incorporating this data and the appropriate GIS files into the new coal resources of Alaska GIS map. This new ArcGIS-based coal resources map of Alaska (fig. 1) meshes well with the NCRDS work by incorporating the coal data into a meaningful and useful format. The map contains compiled geology layers, where available, and coal isopachs where calculated and available. We are also incorporating the Alaska abandoned coal-mine inventory data into this map, which has never been available in a digital format. The complete coal dataset incorporated into this new GIS map will allow for calculations of coal resources in areas with sufficient coal-thickness point-source data. This map will be completed at the end of the current 5-year NCRDS project in the fall of 2015. The final GIS map product will be placed on the DGGS website.

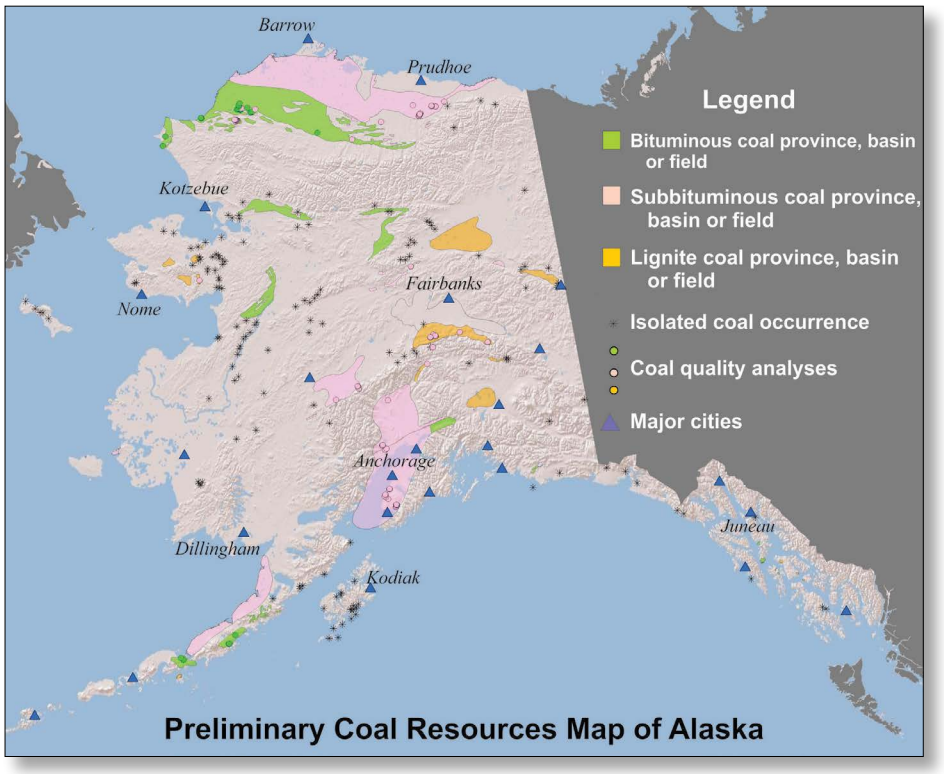

Figure 1. Preliminary draft version of GIS-based coal resources of Alaska map that displays coal provinces, basins, coal fields, and isolated coal occurrences and incorporates NCRDS coal quality point source data.

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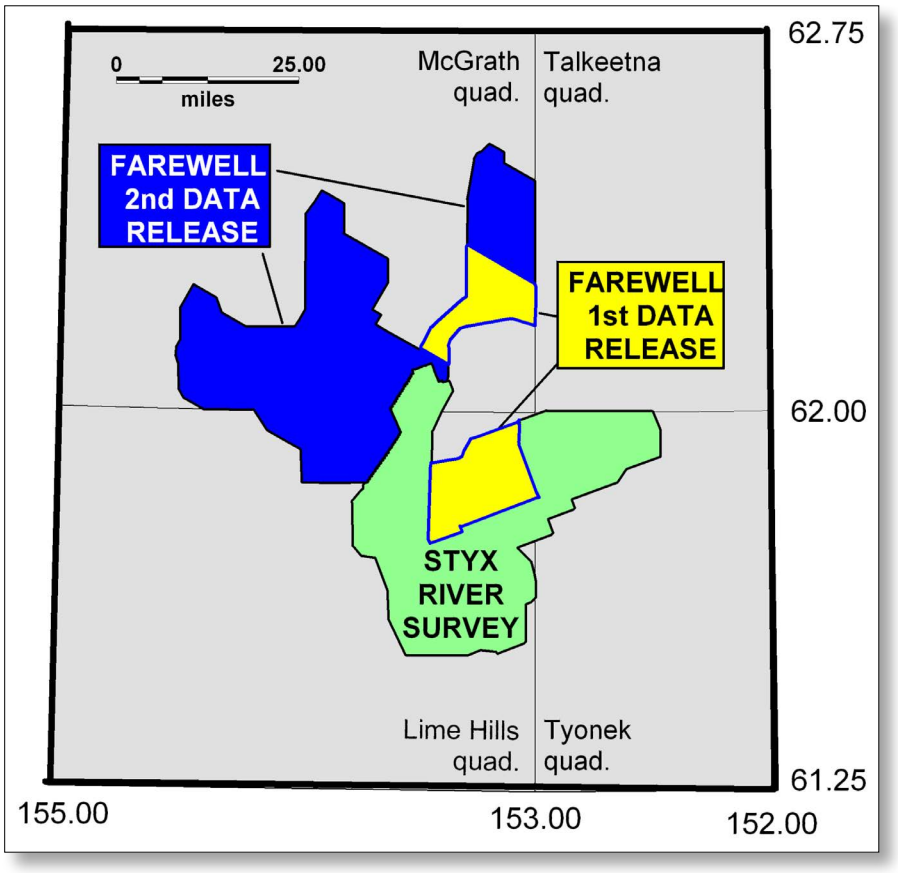
AIRBORNE GEOPHYSICAL/GEOLOGICAL MINERAL INVENTORY PROGRAM: AIRBORNE GEOPHYSICAL SURVEY OF THE FAREWELL AREA, MCGRATH AND LIME HILLS QUADRANGLES, SOUTH-CENTRAL ALASKA

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) 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.

As part of the state-funded AGGMI program, the Strategic and Critical Minerals Assessment project is geophysically surveying 1,045 square miles in the southeastern McGrath and northeastern Lime Hills quadrangles in 2012 and 2013 (see figure). The new survey is adjacent to the Styx River survey released in 2008. Aeromagnetic, electromagnetic, and radiometric data are being acquired. About 240 square miles of the Farewell survey will be released by spring 2013. The remaining areas of the survey will be flown starting in June 2013 and will be released in late 2013 or early 2014. The Farewell survey blocks, located about 135 miles northwest of Anchorage, are over State-owned land except for about 50 square miles of Native-owned land. Most of the land is in the McGrath mining district, and about 18 square miles in the Yentna mining district.



The Farewell geophysical survey is located just south of the Denali-Farewell fault and is underlain by structurally deformed rocks of the Dillinger and Mystic subterranes. The region notably contains numerous, Cretaceous and Tertiary age, plutonic complexes, dike swarms, and volcanic fields, many of which are spatially and genetically associated with mineral occurrences. Most of the abundant mineral prospects and occurrences throughout the area are considered porphyry copper ± molybdenum ± gold deposits and polymetallic veins. Lead-zinc skarns, molybdenum-bearing quartz veins, sediment-hosted base-metal, platinum-group-element, and rare-earth-element deposit types are also present. The areas around Bowser Creek, and the Chip-Loy and Robert's PGM prospects are currently being actively explored, as well as several other areas.

Airborne geophysical surveys combined with detailed geologic mapping will provide a way to differentiate various rock units, especially distinguishing between granitic rocks and the various metamorphic rocks, 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 and geologic data, which lead 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: AIRBORNE GEOPHYSICAL SURVEY OF ANIAK-IDITAROD SUBURBS, IDITAROD, INNOKO, AND ANIAK MINING DISTRICTS, WESTERN ALASKA

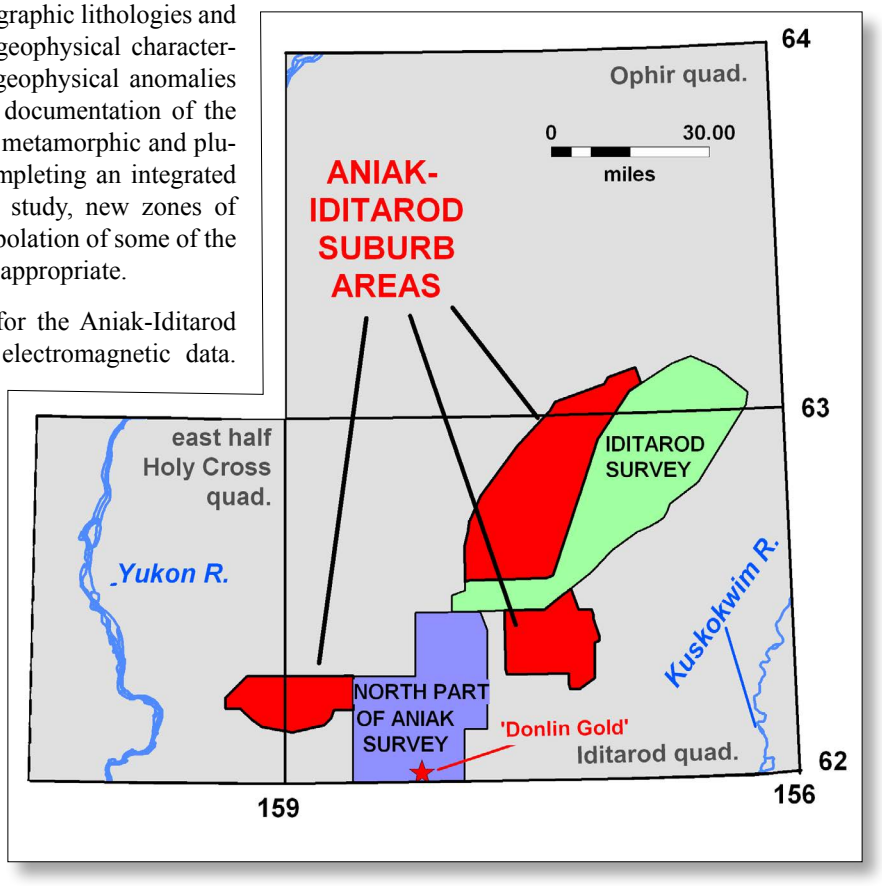
The Airborne Geophysical/Geological Mineral Inventory (AGGMI) program is a multi-year investment to expand the knowledge base of Alaska's mineral resources and catalyze private-sector mineral development. The project seeks to delineate mineral zones on Alaska state lands that: (1) have major economic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

Through the State-funded AGGMI program, DGGS is acquiring airborne-geophysical data for three blocks adjacent to the Iditarod and Aniak surveys in the Iditarod, Ophir, Sleetmute, and Holy Cross quadrangles in FY13 (see figure) and in the Farewell area (see page 34 for project description). The three areas of the Aniak-Iditarod suburbs total 1,029 square miles, and are roughly centered around Flat, Alaska, about 85 miles southwest of McGrath and 275 miles west-northwest of Anchorage. Two thirds of the areas consist of State land, and the remainder consists of Federal land. Most of the survey area is part of the Iditarod-Innoko mining districts, which have produced over 2.3 million ounces of gold; only 3,000 ounces of this production have been from lode sources. The discovery of over 33 million ounces of gold associated with a Late Cretaceous dike swarm at the Donlin Gold deposit, near the center of the three areas, has kept mineral exploration activity high in the region.

Like the Donlin Gold area, most of the survey area is composed of the Upper Cretaceous Kuskokwim Group, a flysch sequence consisting of interbedded sandstone and shale. Most plutons have quartz-monzonitic to monzonitic compositions and are calc-alkaline. Mineralization is thought to be contemporaneous with plutonism at several localities in the region. Besides plutonic-related gold deposits, other lode potential in the survey area includes mesothermal and epithermal deposits that contain mercury, tungsten, silver, antimony, and tin.

Airborne geophysical surveys enable users to delineate regional structures, and identify metamorphic–stratigraphic lithologies and plutonic rock types on the basis of their geophysical characteristics. Follow-up geologic mapping tests geophysical anomalies and interpretations, and provides detailed documentation of the types, locations, and spatial distribution of metamorphic and plutonic rocks and structural features. 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.

Geophysical information being acquired for the Aniak-Iditarod suburb area includes aeromagnetic and electromagnetic data. Maps and digital data will be released as DGGS Geophysical Reports by April 2013. A second publication, containing a project report, interpretation, and electromagnetic anomalies, will be released in late 2013 or early 2014. DGGS believes 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 boundary and the surrounding area.



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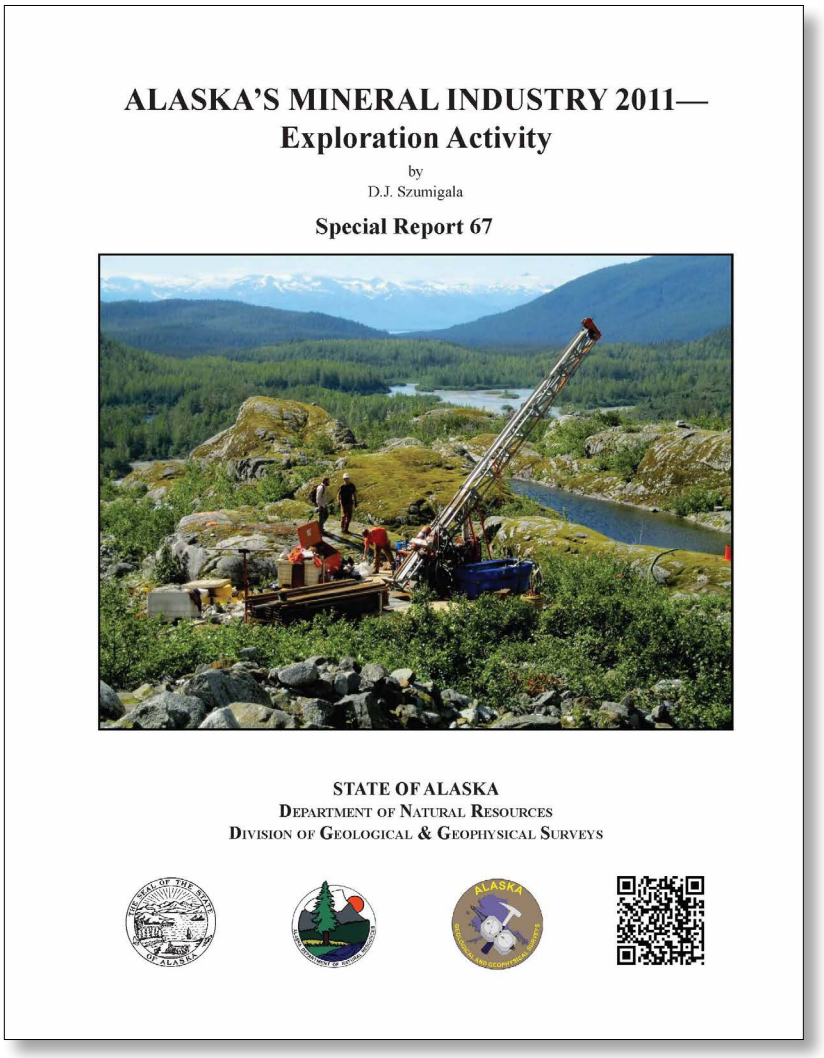
ANNUAL ALASKA MINERAL INDUSTRY REPORT

The Department of Natural Resources' Division of Geological & Geophysical Surveys (DGGS), and the Division of Economic Development (DED) in the Department of Commerce, Community & Economic Development gather, verify, collate, and distribute statistics and summary observations about Alaska's mineral industry and release this information in a timely manner to the public in the form of an annual report. The purpose of this cooperative effort is to supply information to the mineral industry, provide the State and the public with valuable data pertaining to the health of Alaska's mineral industry, and foster 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 chambers 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 in 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. Government personnel rely on the report as an essential tool for formulating public policy affecting resource and land management.

After 30 years of publication, DGGS and DED are working together to evaluate the Alaska Mineral Industry reporting system's methodology of data collection and distribution so that we may more efficiently and comprehensively capture pertinent data and develop report products that will satisfy a broad user base. The agencies are working with industry representatives and the state Minerals Commission to develop a program that is comprehensive and statistically valid, minimizes redundant or archaic data collection methods, and keeps pace with evolving reporting needs. In the interim, DGGS and DED are committed to maintaining uninterrupted collection of mineral exploration and development data. The 2011 Alaska mineral industry exploration activity report, released in November 2012, summarizes information provided through replies to questionnaires mailed by DGGS, phone interviews, press releases, and other information sources. Exploration expenditures for 2011 were at least $365.1 million, up more than $100 million (nearly 40 percent) from the 2010 value of $264.4 million. This marked the seventh consecutive year with exploration expenditures exceeding $100 million, and set a new record for annual mineral exploration expenditures. Alaska mineral exploration expenditures account for approximately one-third of the annual total mineral exploration expenditures in the United States. Development and production data are being reported separately by DED.



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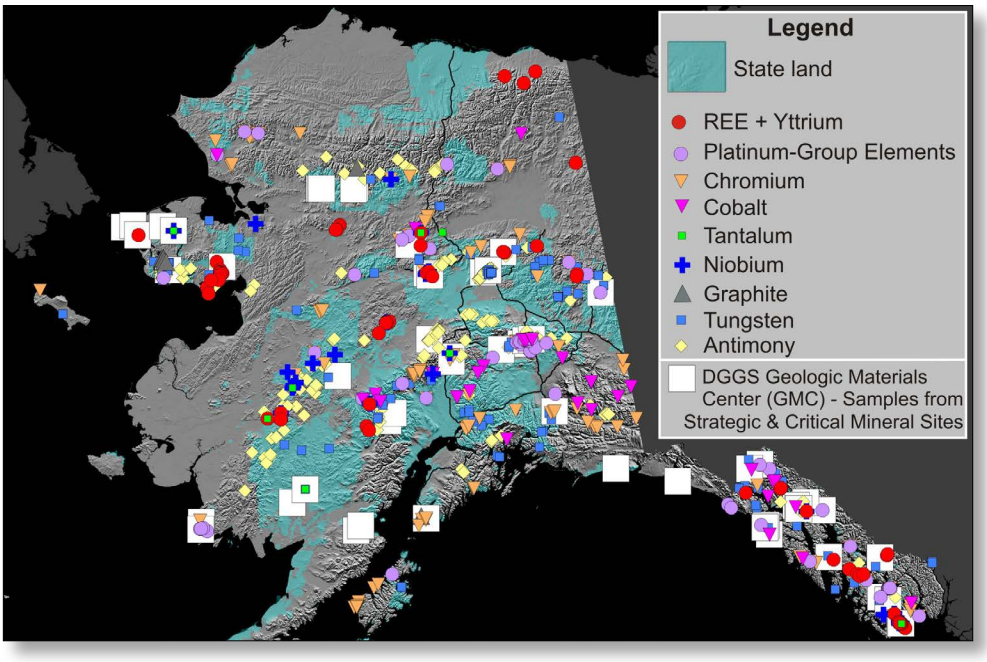
STRATEGIC AND CRITICAL MINERALS ASSESSMENT PROJECT

Strategic and Critical Minerals (SCMs) are essential for our modern, technology based society. For example, platinum-group elements (PGEs) are extensively used in electronics and catalytic converters for vehicles. Rare-Earth Elements (REEs) are necessary for military and high-technology applications, as well as clean/renewable-energy technologies such as wind turbines, solar panels, and batteries for electric vehicles. REEs are used to convert heavy crude oil into gasoline, and are also used to make small permanent magnets, which enable miniaturization of electronic components like cell phones. Current technology and designs of U.S. defense systems depend heavily on REEs. In many cases, there is a lack of effective non-REE substitutes. The current U.S. Geological Survey (USGS) list of SCMs includes REEs, the PGEs, antimony, barium, chromium, cobalt, fluorine, gallium, graphite, indium, niobium, rhenium, tantalum, titanium, tungsten, and yttrium. The U.S. is more than 70 percent dependent on imports for 13 of these 16 elements and elemental groups, and 100 percent dependent on imports for 7. This leaves the U.S. vulnerable to disruptions in the SCM supply chain.



The Alaska Division of Geological & Geophysical Surveys (DGGS) *Strategic and Critical Minerals Assessment* project provides information necessary for comprehensively evaluating Alaska's statewide SCM potential. Many areas of Alaska are geologically favorable for hosting SCMs, but the lack of basic data statewide hinders evaluation of Alaska's SCM potential. Alaska has hundreds of known SCM occurrences (see figure), and millions of acres of selected or conveyed lands with the potential to contain SCMs, but the mineral-resource potential of these occurrences and lands is poorly understood; there has been no modern, systematic resource evaluation for SCMs in Alaska. The DGGS *Strategic and Critical Minerals Assessment* project is specifically designed to address this data and knowledge gap, as described below. By assessing Alaska's potential for SCMs, the State of Alaska will benefit from expanded mineral-industry investment in exploration and development and associated employment, better understand the natural resources of its lands for land-management purposes, and contribute to the nation's need for domestic supplies of these critically important elements.

In FY2011, DGGS initiated the *Rare-Earth Elements and Strategic Minerals Assessment* project, which primarily focused on REEs. In FY2012, DGGS initiated the *Strategic and Critical Minerals Assessment* project, which expands the scope of our work to include select additional elements. The goals of these state-funded capital-improvement projects are: (1) to compile historical and industry-donated data in digital format; (2) to obtain new field and analytical data critical for assessing Alaska's SCM potential; (3) to evaluate the historical and new data to identify areas of Alaska with the highest SCM potential, as well as those needing additional geologic evaluation; (4) to communicate the results of our work to the public; and (5) to publish the data and results of our studies on the DGGS website (free access).

In 2012, the DGGS contracted for a 1,045-square-mile SCM-related airborne geophysical survey in the Farewell area of south-central Alaska (see page 34 for project description) and a 1,029-square-mile survey of three areas in the suburbs of the existing Aniak-Iditarod surveys (see page 35 for project description) of southwestern Alaska. In 2012, DGGS also conducted a 3,500-square-mile field project in the Ray Mountains-Dalton Highway area in Interior Alaska to evaluate its SCM potential (see page 38 for project description). Additionally, DGGS compiled over 5,390 historical geochemical analyses in digital format for areas with SCM mineral potential throughout Alaska, and to date, has obtained new, modern geochemical analyses for over 1,200 archived samples stored at the DGGS Geologic Materials Center. Similarly, in 2013 the DGGS will obtain new analyses from statewide historical samples from State land stored at the USGS Denver Federal Center warehouse. Publication of geochemical data is planned for late 2013. In the summer of 2013, DGGS will conduct additional geologic fieldwork in several areas identified as having high SCM potential.

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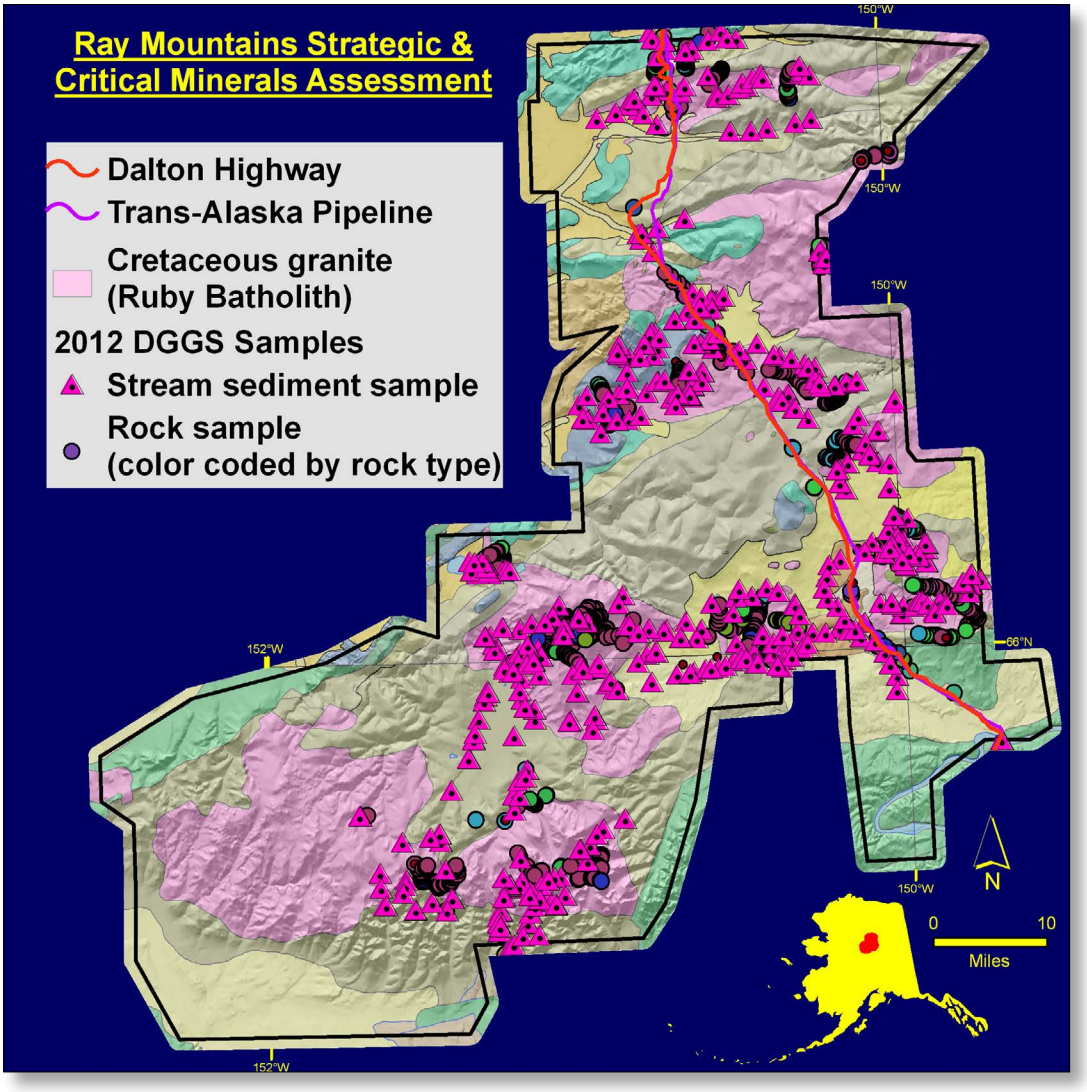
STRATEGIC AND CRITICAL MINERALS ASSESSMENT IN THE RAY MOUNTAINS AREA



During the summer of 2012, the Alaska Division of Geological & Geophysical Surveys (DGGS) conducted field work in the Ray Mountains area of north-central Alaska (see figure) as part of the DGGS *Strategic and Critical Minerals Assessment* project (see page 37). The Ray Mountains area has been recognized, since the 1970s, as having anomalously high values of uranium, thorium, tungsten, tin, and rare-earth elements (REEs). Recent private-sector work highlighted the potential for localized placer-REE concentrations associated with Cretaceous granite. Most of the land in this area is State selected or top filed under U.S. Public Land Order 5150, which closed a large area to mineral entry prior to finalizing the route of the Trans-Alaska Pipeline; the area is currently under U.S. Bureau of Land Management (BLM) jurisdiction. The DGGS field-based assessment in the Ray Mountains area builds upon previous mineral-resource assessments conducted by the U.S. Geological Survey, U.S. Bureau of Mines, and BLM, and is supported by donations of proprietary data from private entities. Evaluation of all available geologic data will allow for science-based prioritization of the State-selected and top-filed lands based on their strategic and critical mineral-resource potential. Products will include interim data releases and a report of investigations that will be made available on the DGGS website (http://dggs.alaska.gov/) in 2013.

The 3,500-square-mile Ray Mountains study area is 125 miles northwest of Fairbanks in the Ray Mountains and Hodzana Uplands. The area extends from east of the Trans-Alaska Pipeline and Dalton Highway corridor, southwest 73 miles to the Ray Mountains. DGGS geologists examined and geochemically sampled known and newly discovered lode and placer occurrences, mapped and sampled granitic rocks, and collected stream-sediment and pan-concentrate samples. The field work and ongoing geochemical, geochronologic, and petrographic studies will allow us to determine appropriate ore deposit models and assess the strategic and critical mineral-resource potential for lode and placer deposits.

Initial results indicate the Cretaceous granites of the Ruby Batholith are variably enriched in REEs and that the REEs occur as widely disseminated accessory minerals. The accessory minerals are released as the granites are eroded, and are subsequently concentrated in ancient and modern river gravels. Further studies will include scientific interpretations of the granite source of the REE minerals, the concentration and type of REEs and other minerals contained in the ancient and modern gravels, and the extent of potentially economic concentrations of REEs and tin in the gravels. Land managers and policymakers will be able to use the results of this study to make informed and logical decisions on prioritization of State-selected lands for potential transfer to State ownership.

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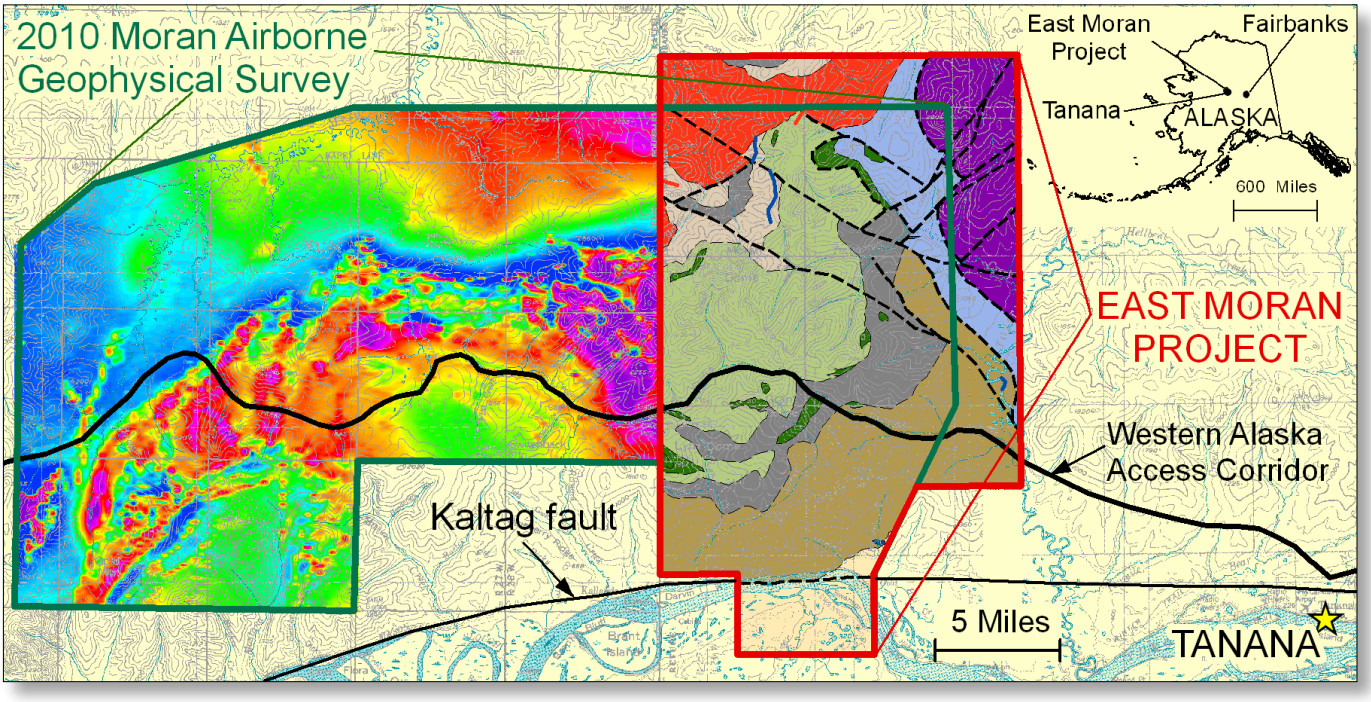
GEOLOGIC MAPPING IN THE EASTERN MORAN AREA, TANANA AND MELOZITNA QUADRANGLES, ALASKA

Historical and active placer mines in the Melozitna mining district, which encompasses the Moran Dome area, have produced more than 12,000 ounces of gold and an undetermined amount of tin, yet little is understood about sources for the placer metals, or the area's gold and polymetallic lode occurrences. To encourage renewed industry exploration for mineral deposits in this region, in 2010 DGGS released the 653-square-mile Moran airborne-geophysical survey (see figure) as part of the State-funded Airborne Geophysical/Geological Mineral Inventory program. The Moran survey area is 150 miles west of Fairbanks, on the north side of the Yukon River between the villages of Ruby and Tanana. The state's preferred Western Alaska Access Corridor transects the survey area. During the summer of 2011, the DGGS geologically mapped 301 square miles in the eastern part, and conducted reconnaissance mapping in the western part of the Moran geophysical survey. Geochemical data from the project were released in 2011 and additional products, including geochronologic data and the final 1:63,360-scale geologic map, will be published in 2013. The products will foster a better understanding of the area's geology and mineral potential. This mapping project was funded primarily by State general funds, with supplemental funding from the federal STATEMAP program through the U.S. Geological Survey.



Prior to 2011, only reconnaissance-level, 1:250,000-scale geologic maps were available for the Moran area; DGGS's 2010 geophysical data indicate the geology is much more complex than shown on these maps. During 2011 fieldwork, DGGS geologists field-checked airborne geophysical interpretations, identified the location, type, and character of bedrock and surficial-geologic units, examined and geochemically sampled known and newly discovered lode and placer occurrences, and determined the location and kinematics of structural features. This detailed geologic framework, supported with ongoing geochemical, geochronologic, and petrographic studies, will allow us to develop deposit models for the area's gold and polymetallic lode prospects and explain the distribution and metal content of local placer deposits. Regional geologic hazards are also of concern, and potentially include the Kaltag fault, which crosses the southern edge of the map area. Part of the 2011 study includes evaluation of possible Holocene and Quaternary displacement history of the Kaltag fault and its associated seismic hazards between Tanana and Ruby.

The primary objective of the eastern Moran project is to map the geology in sufficient detail to inform 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 underexplored gold districts and in strategic and critical minerals. Because economic or infrastructure development could potentially conflict with other land uses, the availability of DGGS's detailed geologic, mineral-resource, and hazard assessments is important for long-range planning by state and local agencies that need to balance resource and infrastructure development with other land-management strategies.

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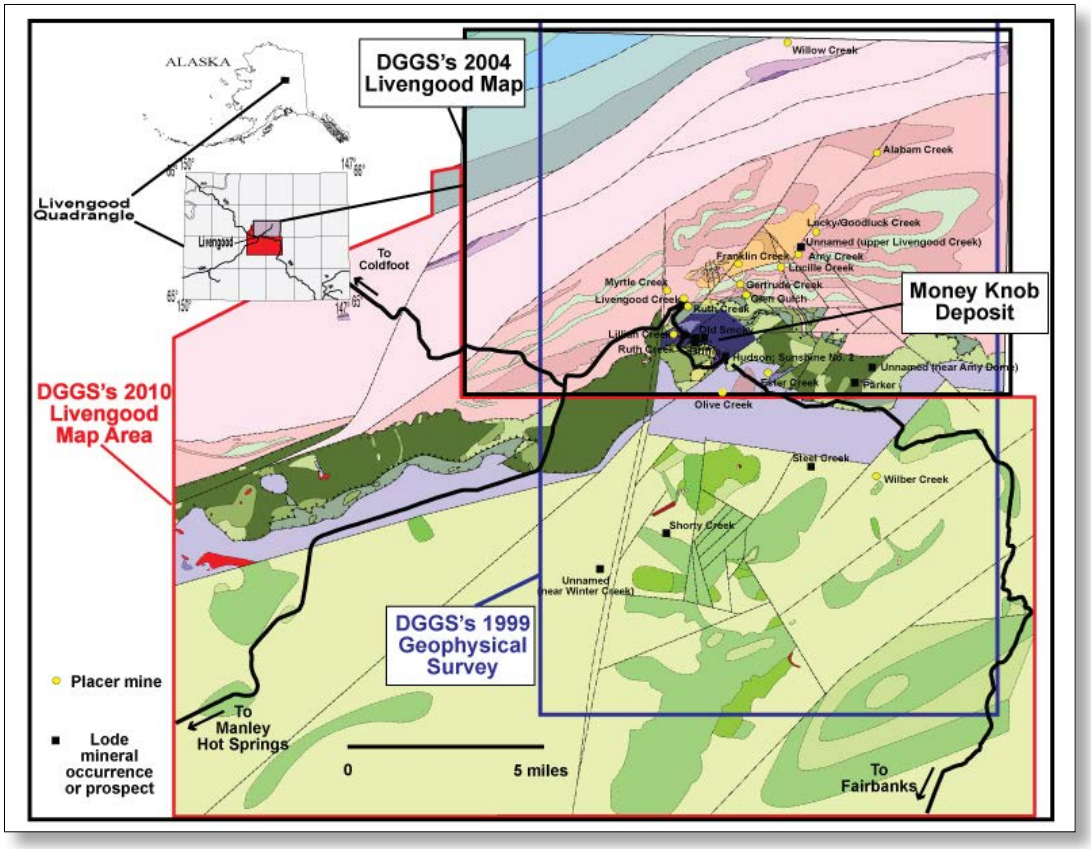
BEDROCK GEOLOGIC MAPPING IN THE TOLOVANA MINING DISTRICT, LIVENGOOD QUADRANGLE, ALASKA

Historical and active placer mines have produced more than 500,000 ounces of placer gold in the Livengood area. To encourage renewed industry exploration for mineral deposits in this region, and to provide geologic data for State and local land-use management, the DGGS has conducted a series of geophysical and geological investigations in the area. This work is part of the Airborne Geophysical/Geological Mineral Inventory (AGGMI) program, supported by State general funds. DGGS released a 230-square-mile airborne-geophysical survey of the Livengood area in 1999. In 2004, DGGS published a geologic map and associated geologic report for an area that includes the northern portion of the 1999 geophysical survey (see figure). Subsequent mineral industry exploration within this map area resulted in the discovery of a large gold deposit at Money Knob, with a defined resource of 20.6 million ounces. In 2010, DGGS conducted geologic mapping and sampling of the southern portion of the 1999 geophysical survey and surrounding area (see figure). A geochemical report for the south Livengood area was published in 2010, and a 1:50,000-scale bedrock-geologic map and accompanying interpretive report will be published in 2013.

The purpose of DGGS's mapping is to provide geologic context for known lode and placer deposits and occurrences, and to evaluate the area's mineral-resource potential. The only known significant lode mineralization within the 2010 map area is located 5.5 miles south of Money Knob at Shorty Creek, a high Ag-Bi-Sn and locally anomalous Au prospect. Felsic igneous rocks spatially associated with the Shorty Creek prospect are compositionally different and temporally about 25 million years younger than the Money Knob gold-related plutonic rocks; hence they represent two different types of mineralizing systems. Rocks of the Cascaden Ridge pluton, 13 km southwest of Money Knob, are compositionally equivalent to Money Knob dikes and, similarly, intrude Devonian volcanic rocks that act as the host rock in the Money Knob system. The Money Knob prospect is currently being further delineated for possible development and production by International Tower Hill Mines.

Wilber Creek is the only creek in the 2010 map area with known placer gold production. Its gold compositions are similar to placer gold of the Livengood area, and the area's present stream morphology suggests the gold is derived from the 2010 map area. Magnetic anomalies in the 1999 geophysical survey indicate a potential igneous source for the Wilber Creek placer deposit. A group of felsic dikes, of similar composition to the gold-related Money Knob rocks, occur within the area and may represent the placer source.

In 2013, DGGS will release an interpretive report and bedrock-geologic map of the entire Livengood study area. These publications will summarize the collective findings of the DGGS 2004 and 2010 investigations, as well as incorporating industry data around the Money Knob deposit. Anglo-Gold (2003-2006) and International Tower Hill Mines Inc. (2006-present) have conducted detailed geologic mapping of Money Knob and the surrounding area, and contributed to geologically subdividing the Paleozoic Amy Creek assemblage, the Cambrian ophiolite package, and the Devonian Cascaden Ridge unit. DGGS also utilized the 2010/2011 lidar survey of the Trans-Alaska Pipeline corridor to identify faults within the map area. The lidar project is described separately (page 43).



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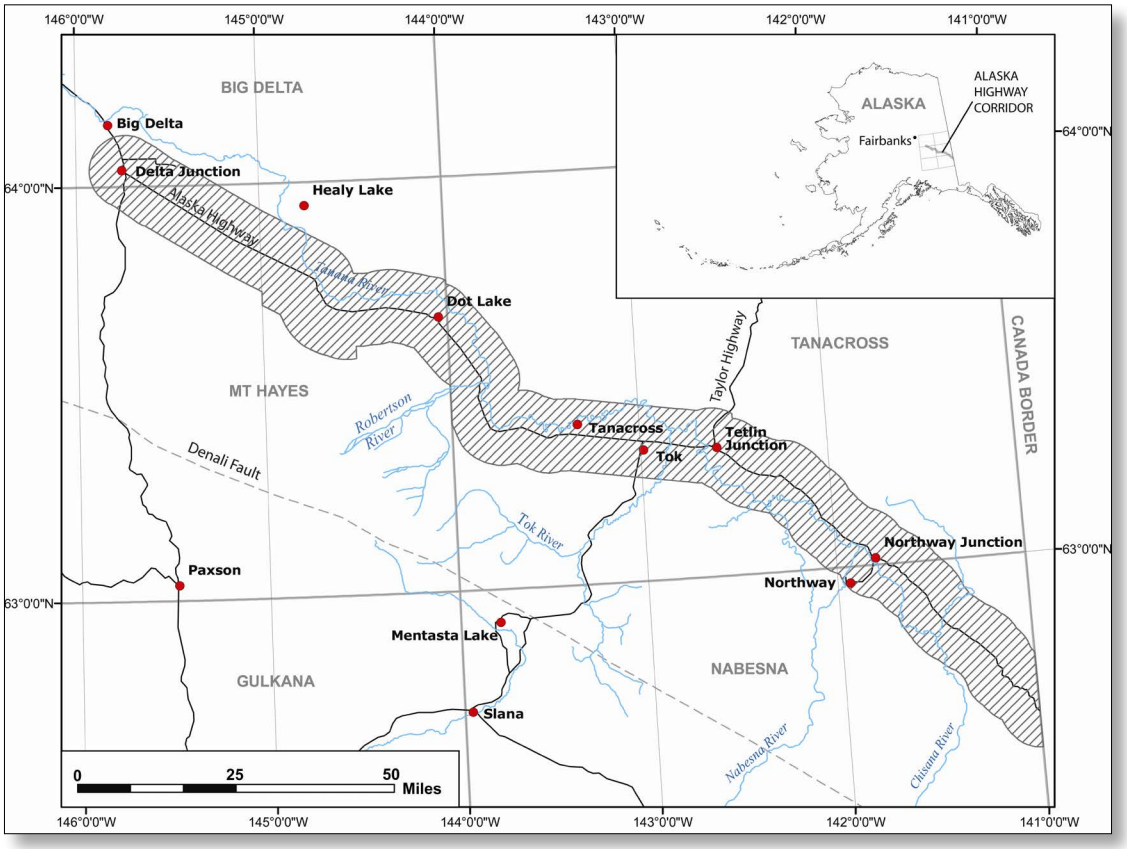
BEDROCK GEOLOGY & MINERAL-RESOURCE ASSESSMENT ALONG THE PROPOSED GAS PIPELINE CORRIDOR FROM DELTA JUNCTION TO THE CANADA BORDER

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 geological and geotechnical work has been published relating to this corridor. This multi-year program, primarily supported by State Capital Improvement Project (CIP) funds, is providing a framework of geologic data upon which engineering, design, and resource decisions may be evaluated for future development between Delta Junction and the Canada 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. In the second phase of the project, DGGS is charged with mapping the bedrock and surficial geology of the area and evaluating the geologic hazards and resources. The surficial-geology and geologic-hazards segments of the project are described separately (page 49).

DGGS staff have completed the field data collection phase needed to assess the mineral resources of the area and create a 1:63,360-scale bedrock-geologic map. In 2006 and 2007, DGGS conducted geologic fieldwork between Delta Junction and Dot Lake, in 2008 between Dot Lake and Tetlin Junction, in 2009 between Tetlin Junction and the Canada border, and in 2010 from Delta Junction to the Canada border.

The bedrock maps incorporate interpretations of DGGS's airborne magnetic and resistivity data, field data, and various scientific analytical data. The geophysical data are particularly valuable for interpreting the geology in areas covered by surficial deposits or vegetation. Numerous plutonic rock suites were defined; these plutons intruded complexly deformed, amphibolite-facies metasedimentary and metaigneous rocks similar to those elsewhere in the Yukon–Tanana Upland, as well as a suite of greenschist-facies metasedimentary rocks and metamorphosed mafic intrusions, which likely correlate with similar units directly across the border in Canada. DGGS also determined the location and kinematics of many smaller-scale faults in the corridor that are related to the Denali fault system; these data will provide a better understanding of the history and potential impacts of these faults.

DGGS also evaluated the mineral-resource 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, and U-Pb and $^{40}Ar/^{39}Ar$ age dates for samples collected during 2008–2010 fieldwork will be published in 2013. The three bedrock-geologic maps for the proposed gas pipeline corridor segments will also be published in 2013.



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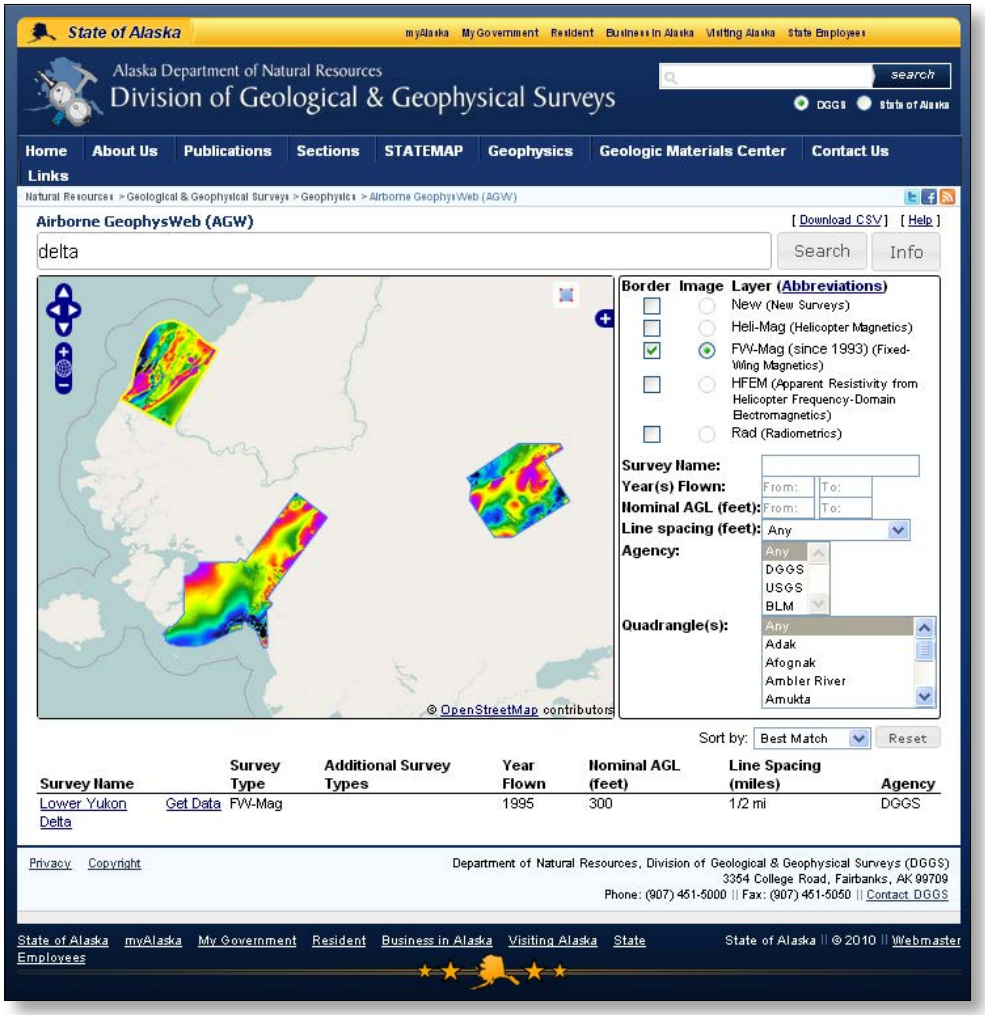
DISCOVERING ONLINE ALASKA GEOPHYSICAL DATA: AIRBORNE GEOPHYSWEB

As part of the Airborne Geophysical/Geological Mineral Inventory (AGGMI) program (see pages 34 and 35), DGGS is developing an online application to facilitate public discovery of published airborne geophysical data in Alaska. The Airborne GeophysWeb application contains an interactive map interface and text-search capability to easily search for and locate airborne geophysical datasets published by DGGS, U.S. Geological Survey, and Bureau of Land Management (BLM) since 1993. The application displays a representative image for each survey area and type of survey so users can get an idea of what the processed dataset might look like before they download the information.

Details about the geophysical surveys that will be available through GeophysWeb include publication information, airborne geophysical data collection parameters, and information about the representative images displayed in the application. These data will also be available as a separate downloadable text file. The detailed information will help users understand the intricacies of the datasets and process the data appropriately for their purposes. The application will be kept current as older datasets are published or revised, and newly acquired data are published. The survey outlines and detailed information may be published as a downloadable GIS file in the future.

Airborne geophysical data are used to delineate regional geologic structures and identify rock types based on their geophysical signatures in conjunction with information collected from "boots on the ground" field work. Geophysical data are often used to help delineate mineral exploration targets and areas of interest and may also be used for energy exploration and locating natural hazards like permafrost.

DGGS anticipates the application will be released by early-spring 2013 through DGGS's interactive map splash page: http://maps.dggs.alaska.gov. Geophysical survey area outlines and supporting information will also be released as a Web Feature Service (WFS), a real-time, online data format supported by most Geographic Information Systems (GIS) software. DGGS believes this online tool will lead to better access and increased use of important airborne geophysical data critical to the understanding of the framework geology of the state and its resources.



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ALASKA STAND-ALONE GAS PIPELINE GEOHAZARDS STUDY

In 2012, the Alaska Division of Geological & Geophysical Surveys (DGGS) continued investigating geologic hazards along the proposed Alaska Stand-Alone Pipeline (ASAP) from Anchorage to Prudhoe Bay (fig. 1). The ASAP project is a proposed in-state pipeline designed to bring long-term supplies of natural gas from the North Slope to the Fairbanks and Cook Inlet areas. The purpose of the DGGS investigation is to characterize a variety of potential geologic hazards including earthquakes, slope instability, and cryogenic processes that could potentially affect pipeline route feasibility, design, and construction. DGGS's approach is to perform reconnaissance geohazards evaluations along the proposed pipeline alignment on a quadrangle-by-quadrangle basis and to conduct more-detailed studies where warranted.

During the 2012 summer field season, DGGS geologists conducted detailed analyses aimed at better characterizing fault rupture parameters associated with the Castle Mountain and Denali faults (figs. 1 and 2). This effort utilized lidar data acquired by DGGS in 2010-2011 to refine helicopter-based preliminary field observations from the prior field season. The project's Geographic Information System (GIS) database was updated to reflect observations from summer 2012 and provides a permanent archive of field data, Quaternary geology and geologic hazards, including the locations of Quaternary-active fault traces.

DGGS geologists have completed geologic-hazard mapping along the segment of the proposed pipeline route between Anchorage and Livengood. These draft maps include data tables that describe hazard types and pertinent observations from each site. Important details related to pipeline design and construction such as location, distribution, and relative importance of specific geologic hazards are currently being described in a summary geologic-hazards report. The report and associated maps will serve as a template for planning our geologic-hazards assessment program for the Livengood to Prudhoe Bay segment, which will be assessed in 2013. The final published report for the entire route is anticipated to be completed in 2014 and will include a description of fault displacement parameters necessary for adequate pipeline design considerations.

Funding for this project is provided by the Alaska Gasline Development Corporation.

Figure 1. Geologists standing at the top and bottom of a fault scarp associated with the Castle Mountain fault. Photograph taken by Rich Koehler, June 2, 2012.

Figure 2. Complex left-stepping fissures along the Denali fault east of Cantwell. Rupture pattern possibly related to rupture of frozen fan gravels and rotation of intact blocks. Photograph taken by Rich Koehler, June 13, 2012.

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ASSESSMENT OF FLOOD HAZARDS IN THE VALDEZ GLACIER WATERSHED

Glaciers serve to regulate runoff events in alpine catchments throughout Alaska by acting as storage units for precipitation and meltwater and providing stream flow during dry periods. Recent mass balance studies on south-central and southeastern Alaska glaciers indicate that many glaciers in these regions have been decreasing in volume over the past 60 years in response to a warming climate. Alaska communities and infrastructure located in valleys downstream of these glaciers can be susceptible to flooding resulting from extended periods of glacier melting and glacial lake outbursts. These events have the potential for endangering life, disrupting the livelihoods of Alaskans, and impacting the state's economic activity.

In spring 2012, scientists from the Alaska Division of Geological & Geophysical Surveys (DGGS) and the University of Alaska Fairbanks began collecting detailed simultaneous measurements of glacier mass balance and basin hydrology in the Valdez Glacier catchment (figs. 1 and 2). The goal of this work is to develop more accurate predictions of glacier-related flood hazard potential for the community of Valdez. The results will be useful to community planners, the State of Alaska, and other stakeholders potentially impacted by flood events in this area. Methods developed in the Valdez study will serve as a template for future projects aimed at assessing potential hazards to communities downstream from glacier watersheds.

Work on the Valdez project will continue in 2013 and is supported through DGGS's Climate Change Hazards Program by a State of Alaska Capital Improvement Project (CIP). Preliminary data includes a bathymetric map of Valdez Glacier lake that will be published in spring 2013. The final report is expected to be released in 2014.

Figure 1. Jennifer Davis (DGGS/UAF) and Gabriel Wolken (DGGS) installing ablation stakes and temperature/relative humidity sensors on Valdez Glacier. (Photo credit: G. Wolken)

Figure 2. Alessio Gusmeroli (UAF/IARC) and Anthony Arendt (UAF/GI) collecting snow depth measurements using ground penetrating radar (GPR) and manual probing methods in the Valdez Glacier watershed. (Photo credit: G. Wolken)

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GEOHAZARD EVALUATION AND GEOLOGIC MAPPING FOR COASTAL COMMUNITIES

According to the 2010 United States census, more than 60 percent of Alaskans reside in coastal communities. Many of these communities are vulnerable to a wide range of geologic hazards, including erosion, landslides, wave attack, storm surge/flooding, tsunami, and ivu (ice push). Since 2004, reports and recommendations from the U.S. General Accounting Office, the U.S. Army Corps of Engineers, and the Immediate Action Work Group of the Governor's Subcabinet on Climate Change have highlighted the imperiled or at-risk status of many Alaskan villages that are subject to severe flooding and erosion and have recommended baseline hazard evaluations. In response to both existing risks and to shifts in the frequency and/or magnitude of geohazard-triggering events influenced by a changing climate, communities throughout the state are becoming increasingly involved with mitigation or adaptation efforts. Baseline data pertaining to local geology, coastal and oceanic processes, and historic natural hazard events are necessary to facilitate these efforts (fig. 1).

In 2009, DGGS received federal funding through the Coastal Impact Assistance Program (CIAP) to establish a coastal community geohazards evaluation and geologic mapping program in support of local and regional planning. Following an extensive review of existing data and consultation with numerous agencies and affected coastal districts, a prioritized list of target communities was developed (fig. 2). The program was launched in 2010 with a pilot project in Kivalina, which leveraged State CIP funds and federal STATEMAP funds from the U.S. Geological Survey for an expanded project scope. Subsequent fieldwork has been conducted in six additional communities and includes field efforts to rapidly document the impacts of severe storms on Alaska's coast.

The DGGS Coastal Hazards Program is on track to assess the geologic context and dominant coastal processes near at least ten Alaskan communities by FY15. A coastal geohazard map series stemming from these field investigations is tailored to the specialized needs of Alaska and identifies 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. Where necessary, surficial-geologic mapping (1:63,360 scale) is also being undertaken. These maps will be published in GIS format with standard metadata and will be available to the public approximately two years after initial field work at each location. For communities that are seeking to relocate or to establish evacuation shelters/routes, these products will be useful planning tools for informed decision making because they delineate areas where geologic hazards should be considered at a more detailed level to fully evaluate construction risk, identify potential sources of construction materials, and ensure that planned and proposed development will not exacerbate existing hazards.

In FY13, new partnerships with the Western Alaska Landscape Conservation Cooperative and the NOAA ShoreZone Imagery program have allowed the program to improve data collection efforts, such as through the addition of nearshore bathymetric measurement capability. Ongoing consultation and coordination with the Alaska Division of Community & Regional Affairs, U.S. Army Corps of Engineers, Alaska Department of Transportation & Public Facilities, U.S. Geological Survey, National Oceanic and Atmospheric Administration, affected coastal communities, and private-sector geotechnical consultants will continue to shape this program and avoid any duplication of efforts.

Figure 1. A DGGS field crew installs a temporary water level gauge in Shishmaref Inlet, August 2012. In addition to documenting water levels, extensive topographic and bathymetric measurements are collected from throughout the coastal zone in each field area. (Photo by Owen Mason)

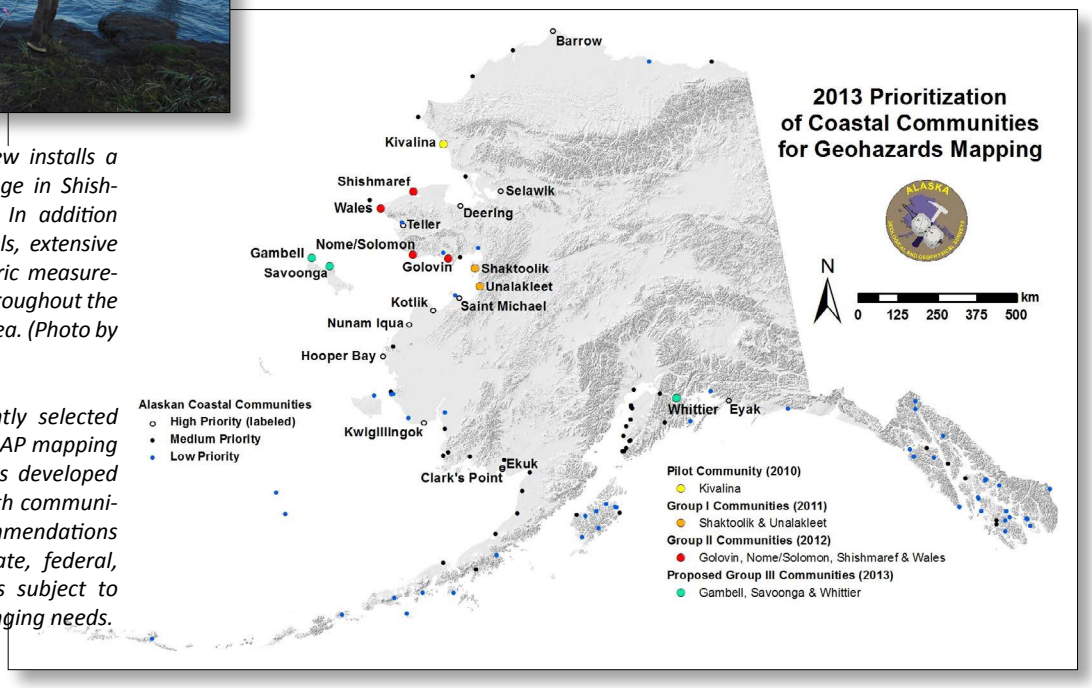

Figure 2. Locations currently selected for inclusion in the DGGS CIAP mapping program. Prioritization was developed through direct dialogue with community leadership and the recommendations and activities of other state, federal, and local agencies, and is subject to revision in response to changing needs.

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GEOLOGIC CONTRIBUTIONS TO THE PROPOSED SUSITNA–WATANA HYDROELECTRIC PROJECT, ALASKA

The Alaska Energy Authority (AEA) has been authorized by the State of Alaska to develop the Susitna–Watana Hydroelectric Project on the Susitna River, Alaska (fig. 1). The purpose of the project is to help meet the future electrical needs of Alaska's Railbelt Region by providing clean, renewable energy at the lowest possible long-term cost. Located approximately halfway between Anchorage and Fairbanks on the upper Susitna River, the 700-foot-high Susitna–Watana dam is expected to have a reservoir 39 miles long and up to 2 miles wide, with an average annual power generation of 2,600 GWhrs (AEA). The powerhouse, dam, and related facilities would be linked by a transmission line to the Railbelt Intertie, as well as to road or railroad access from the Parks or Denali highways.

Figure 1. The Susitna–Watana Hydroelectric Project will provide power to meet the electrical needs of Alaska's Railbelt Region. Map by the Alaska Energy Authority, http://www.susitna-watanahydro.org.

An accurate assessment of the site geology and potential for seismic and other geologic hazards is essential for dam location, design, and construction. The Alaska Division of Geological & Geophysical Surveys (DGGS) is evaluating seismic-hazard issues and producing GIS-based geologic maps in support of the hydroelectric project. Planned work in this AEA-funded study includes map and data compilation and assessment of existing geologic and seismic hazards data. Information developed in the course of this project will be disseminated through publicly available maps and reports published by DGGS.

DGGS geologists have completed reviews of existing and new AEA-contractor-developed seismic hazards reports, and have gathered, reviewed, and compiled existing hardcopy geologic maps into a digital GIS database (fig. 2). The Phase 1 compilation maps and geodatabase are anticipated to be published in early 2013. Future work is dependent on additional funding but may include Phase 2 field-based verification to improve and expand the body of geologic and seismic-hazards data needed to fully meet the requirements of this major hydroelectric project, and a Phase 3 wrap-up of the geologic evaluation with final field checks, additional data analysis, and report writing.

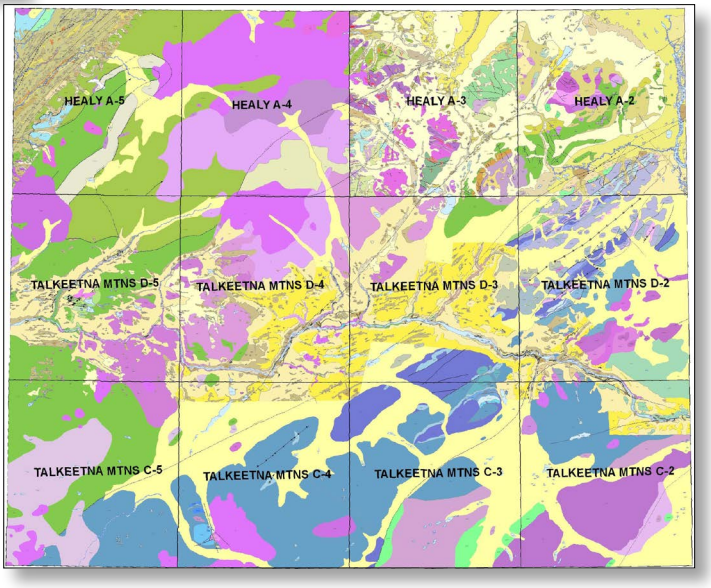

Figure 2. The most current and detailed geologic mapping for twelve inch-to-mile quadrangles has been compiled into a single geodatabase, along with georeferenced scans and digitized vector files of the original source maps. This will be a valuable geologic data resource for developers, planners and scientists working on the hydroelectric project, as well as for any other projects in the area.

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ASSESSMENT OF GEOLOGIC HAZARDS ASSOCIATED WITH CLIMATE CHANGE

Most high-latitude northern regions have undergone rapid and substantial warming over the last few decades. Alaska is particularly sensitive to the effects of climate warming as much of its social and economic activity is strongly influenced by the presence of snow, ice, and permafrost. Changes in climate can modify natural processes and increase the magnitude and frequency of certain types of geologic hazards (such as flooding, erosion, slope instability, and thawing permafrost) and, if not properly addressed, have a direct effect on Alaska communities and infrastructure as well as on the livelihoods and lifestyles of Alaskans. The State can help preserve the integrity of its infrastructure and the health and safety of its people by being prepared for potential emergency situations resulting from geologic hazards that are caused or amplified by climate change. A critical first step is to perform the necessary sound science to identify high-risk areas where proactive mitigation efforts will be needed and useful, and areas where design structure and informed planning can alleviate the need for future mitigation.

The Division of Geological & Geophysical Surveys' (DGGS) Climate Change Hazards Program has been developed to rigorously assess geologic hazards associated with climate change and publish information that can be used for proactive planning, hazard mitigation, and emergency response in high-risk communities and developing areas. DGGS is accomplishing this by collecting the necessary field data to assess geologic hazards and publish peer-reviewed geologic-hazards maps and reports of high-risk communities and infrastructure in Alaska. We are completing these assessments at local and/or regional scales as needed to address specific local problems and to understand and evaluate the larger geologic context. This effort is in collaboration with relevant organizations including local city officials, the Alaska Department of Transportation & Public Facilities (DOT&PF), the U.S. Geological Survey (USGS), and the University of Alaska Fairbanks, and will provide valuable information to allow planners and design engineers to minimize the economic impacts and public safety risks associated with geologic hazards.

In 2012 DGGS scientists conducted field-based geologic hazards assessments and mapping in and around the communities of Seward, Valdez, and Whittier (fig. 1). We anticipate publishing final products for Kivalina and completing draft products for Koyukuk, Seward, and Whittier in 2013. Geologic-hazards maps will delineate areas where potential natural hazards such as snow avalanches, flooding, erosion, slope instability, and thawing permafrost should be considered at a more detailed level to fully evaluate risk for any given use and will be published in digital GIS format in conformance with national standards. Reports describing the geology and hazards will accompany the maps.

The Climate Change Hazards Program is funded by the State of Alaska as a Capital Improvement Project (CIP), with additional support for the Kivalina work from the USGS STATEMAP program.

Figure 1. Matthew Balazs (DGGS/UAF) takes notes in his fieldbook during a Ground Based Interferometric Radar (GBIR) scan of the slope behind Begich Towers in Whittier, Alaska. (Photo credit: G. Wolken).

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GEOLOGY AND GEOLOGIC HAZARDS IN THE WHITTIER AREA, SOUTH-CENTRAL ALASKA

The town of Whittier, Alaska (pop. 225) is an all-weather, ice-free port crucial to the state, and one of only two serving the mainland via both railroad and road access. During the 1964 M9.2 great Alaska earthquake, Whittier suffered catastrophic tsunami damage, including loss of life. While not as widely known or as thoroughly studied as tsunamis caused by tectonic motions during earthquakes, landslide-generated tsunamis, such as those that devastated Whittier during the 1964 earthquake, can cause loss of life and significant damage to property and infrastructure with little or no warning. During summer 2011, DGGS geologists identified a large, fresh-looking bedrock fracture above the north shore of Passage Canal across from Whittier. The fracture is evidence of an unstable slope that, if mobilized, has the potential to generate a local tsunami capable of impacting the community of Whittier and damaging critical infrastructure along Passage Canal. Initial modeling of two hypothetical slides and resulting tsunamis suggests maximum wave heights of about 10 feet (see DGGS RI 2011-7, Appendix B). However, DGGS is undertaking collection of additional field-geologic and lidar data, as described below, to better evaluate the risks from this and other hazards in the Whittier area.

DGGS initiated a project in 2012 to map the geology and geohazards near Whittier (fig. 1) and collect high-resolution lidar data over key portions of the area (fig. 2). Given the high cost of mobilizing a helicopter-supported field program, DGGS expanded the size of the study area to include the heavily-visited Begich-Boggs Visitors' Center at Portage Lake and the Anton Anderson Memorial Tunnel to take advantage of the opportunity to assess the potential geologic hazards that could impact this significant infrastructure. Previous geologic mapping in the area has been of a reconnaissance nature and at a small scale. Detailed stratigraphic and structural information is sparse and geologic maps are too regional for assessment of specific geologic hazards. This project is allowing us to map surficial and bedrock geology at inch-to-mile scale and assess natural hazards in support of informed, proactive community planning, mitigation, and emergency response in and around this high-risk community and its associated critical infrastructure. The project is jointly funded by the U.S. Geological Survey STATEMAP program and by the State of Alaska as a Capital Improvement Project (CIP).

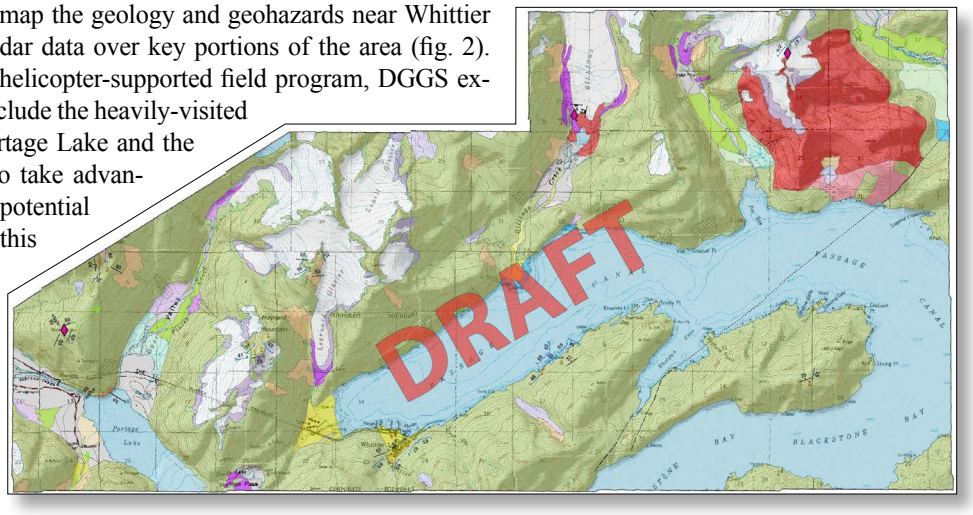

Figure 1. Preliminary geologic map of the Whittier area.

Products for this project include public release of the lidar data in spring 2013, a preliminary map of geology and geologic hazards that is due to the U.S. Geological Survey in May 2013, and a final, peer-reviewed map that is scheduled to be published in summer 2013. An additional detailed geologic hazards report will be published in conjunction with the DGGS Climate Change Hazards Program.

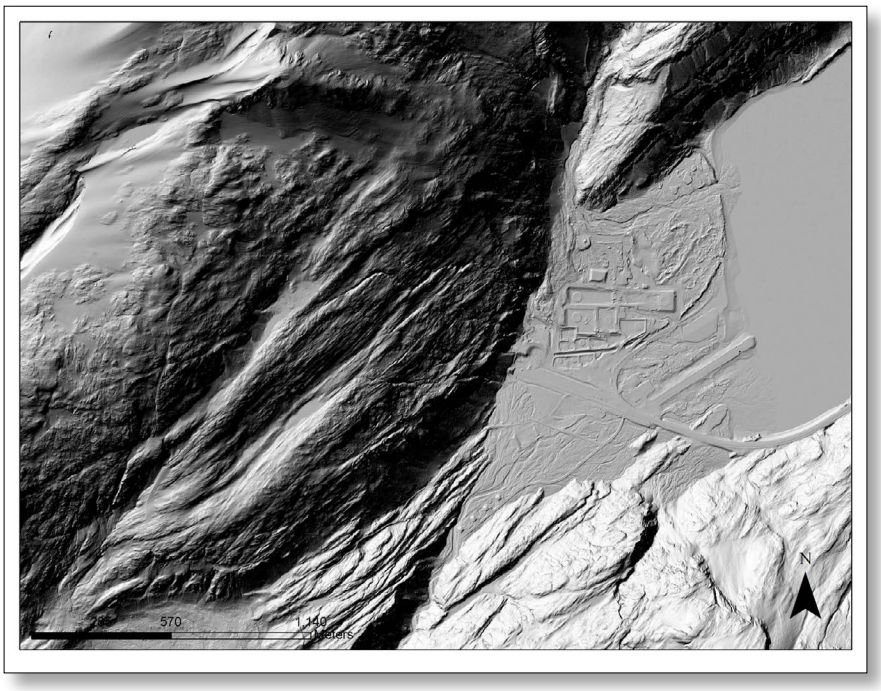

Figure 2. High-resolution lidar data such as this preliminary hillshade image will be used to refine the geologic mapping and to help identify and characterize potential geologic hazards that may not be as discernible in aerial photographs and satellite imagery due to thick vegetation cover. This image shows the area around the eastern entrance of the Anton Anderson Memorial Tunnel and Whittier air strip.

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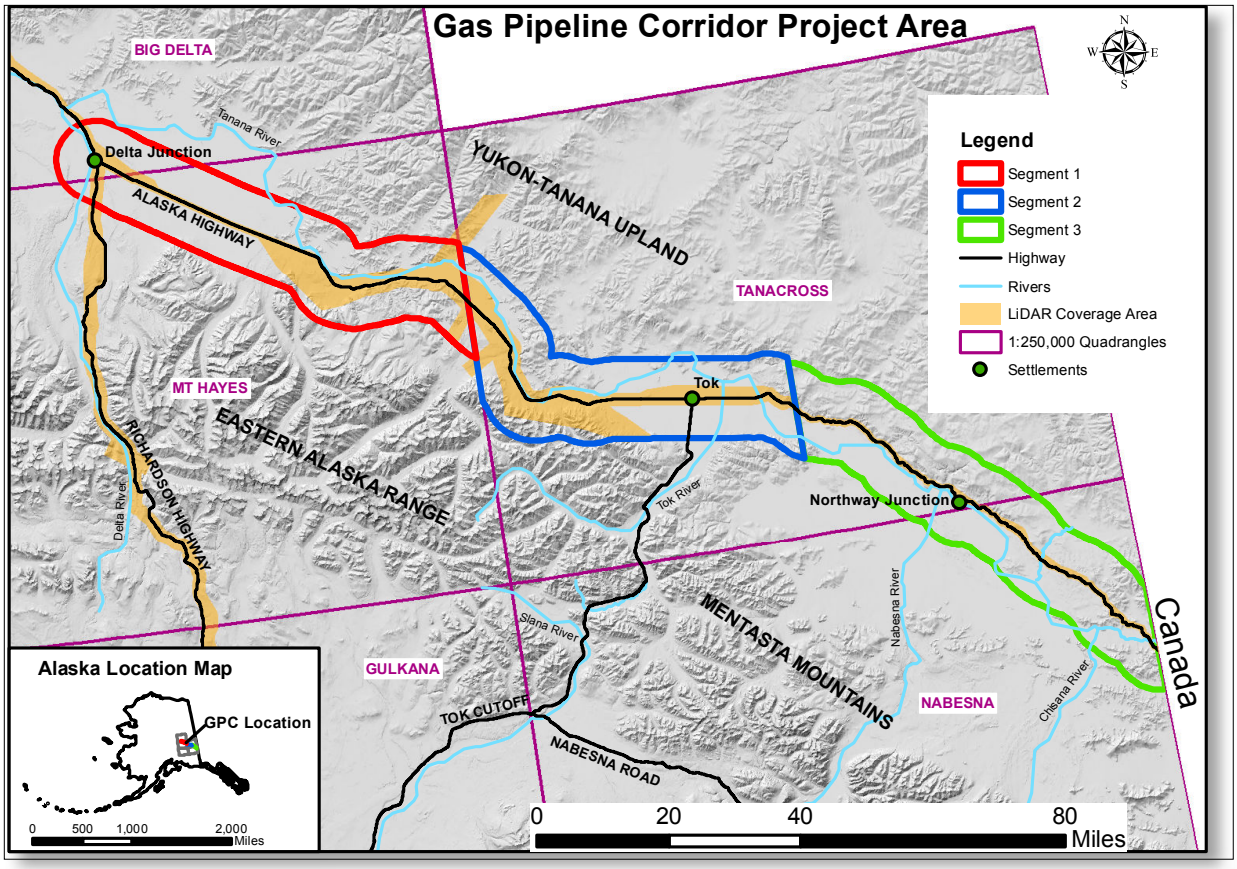
GEOLOGY, GEOHAZARDS, AND RESOURCES ALONG THE PROPOSED NATURAL GAS PIPELINE CORRIDOR, ALASKA HIGHWAY, FROM DELTA JUNCTION TO THE CANADA BORDER

In preparation for possible construction of a natural gas export pipeline, the Alaska Division of Geological & Geophysical Surveys (DGGS) has been evaluating the geology, geohazards, and material resources along a 12-mile-wide corridor centered on the Alaska Highway from Delta Junction to the Canada border. Planned products for each of three segments along this route include preliminary maps and reports describing surficial geology, bedrock geology, permafrost, engineering geology, and potentially active faults. Surficial geology, bedrock geology, permafrost, and engineering reports include 1:63,360-scale reconnaissance maps and digital GIS data. These preliminary products will be followed by a final comprehensive report that compiles and synthesizes data for the entire project area.

DGGS is now completing work on the third and final segment of the corridor, between Tetlin Junction and the Canada border. The surficial geology and permafrost reports and accompanying maps were published in 2012 and the engineering-geologic maps for this segment are anticipated to be released in early 2013. In addition to the maps and reports described above, DGGS plans to publish bedrock maps and associated GIS data for all three segments of the corridor in 2013 (see separate briefing paper, page 41). This will complete the publication of materials for each of the 3 individual segments of the corridor.

During 2012, DGGS conducted desktop studies and field work to evaluate high-resolution lidar within the corridor to refine geologic mapping and interpretations for the final comprehensive report. This report will describe permafrost, surficial geology, and geologic hazards, including active faulting, for the entire project area. DGGS plans to complete a draft report and accompanying set of maps, with seamless GIS layers, which will be ready for review in 2013. In conjunction with this project, DGGS is also finalizing a guidebook describing the roadside geology of the Alaska Highway and the Tok Cutoff to Nabesna Junction. We anticipate this will be ready for peer review in 2013.

The Gas Pipeline Corridor project is funded by the State of Alaska as a Capital Improvement Project (CIP), with additional funding provided by the U.S. Geological Survey STATEMAP program.



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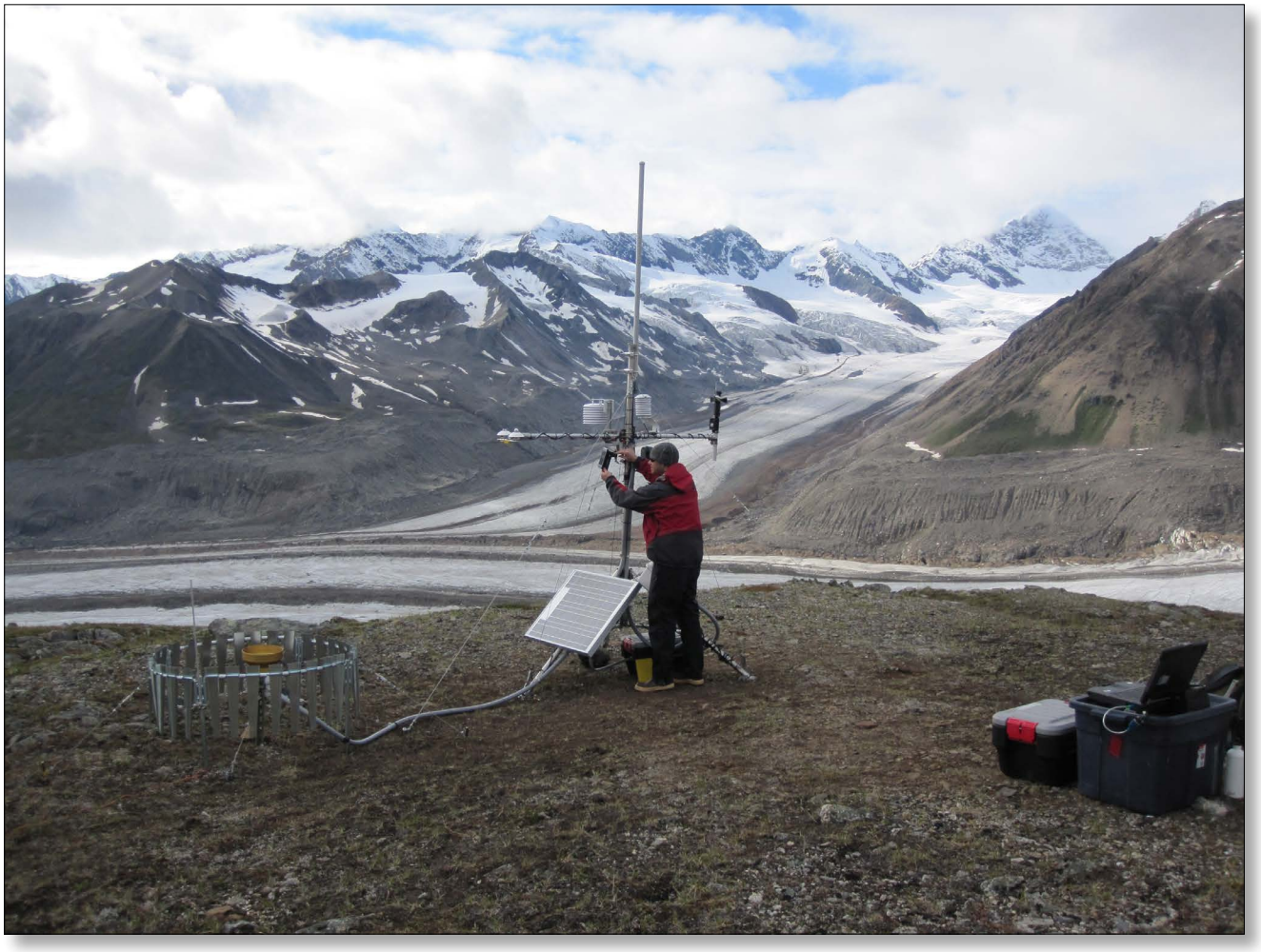
GLACIER AND RUNOFF CHANGES IN THE UPPER SUSITNA BASIN

The Alaska Energy Authority (AEA) has been authorized by the State of Alaska to develop the Susitna-Watana Hydroelectric Project on the Susitna River to serve the Railbelt's energy needs. Critical to any such development is a thorough understanding of the basin-wide contributions to river runoff and how these might change over time to influence the quantity and seasonality of flow into a hydroelectric reservoir. To accomplish this goal, the Alaska Division of Geological & Geophysical Surveys (DGGS), along with collaborators from the University of Alaska Fairbanks, began in 2012 a multi-year, AEA-funded study of the hydrology of the upper Susitna drainage basin, with a particular focus on modeling the effects of glacier wastage and retreat on streamflow. The study combines field measurements and computational modeling to improve estimates of runoff into the proposed 31 mi^2, 40-mi-long reservoir of the Susitna-Watana Hydroelectric Project.

Changes in glacier volume and extent and/or altered precipitation regimes in response to climate warming have the potential to substantially alter the magnitude and timing of runoff. Although only about 4 percent of the Susitna watershed area (5,127 mi^2) is glacierized, these glaciers provide a significant proportion of the total runoff within the upper Susitna drainage, and it is well documented that these glaciers are currently retreating. Given this trend, changes to the runoff represented by glacial melting may occur in the near future and may impact the hydroelectric project. Understanding of how changes to the upper Susitna basin hydrology due to glacier retreat can affect hydroelectric project operations is necessary for informed evaluation of potential protection, mitigation, and enhancement measures.

Preliminary results from this multi-year project will be provided to AEA by January 2014, with final reports published in 2015 and 2016 as the data collection and modeling efforts are completed.



DGGS geologist Gabriel Wolken installing a weather station in the upper Susitna basin, central Alaska Range. Tributaries to the Susitna Glacier are visible in the background. (Photo credit: G. Wolken)

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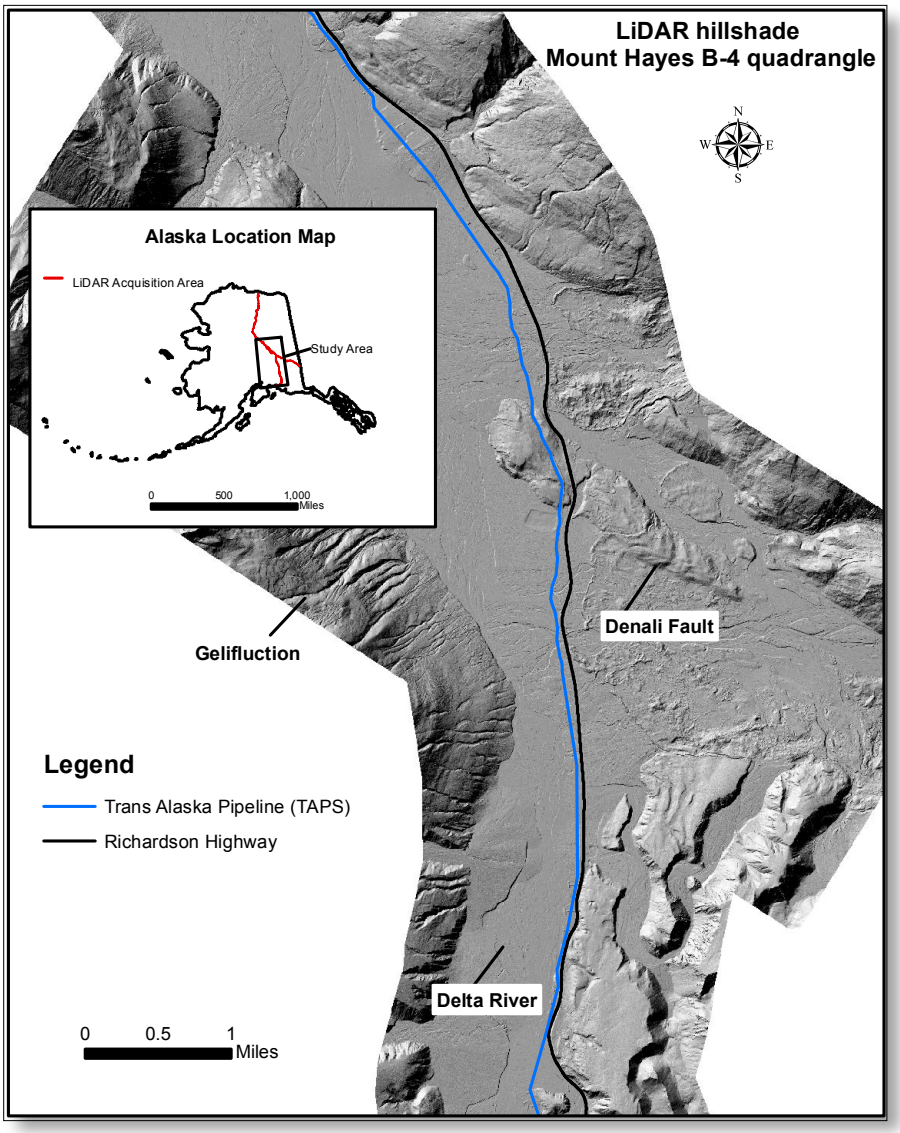
LIDAR-SUPPORTED ASSESSMENT OF GEOLOGY AND GEOHAZARDS IN THE LIVENGOOD-VALDEZ CORRIDOR

The Division of Geological & Geophysical Surveys (DGGS), with support from the Alaska Gas Pipeline Project Office, the Office of the Federal Coordinator, and the Alaska Gasline Development Corporation, completed in 2010-2011 acquisition and public release of approximately 3000 mi^2 of high-resolution lidar (light detection and ranging) data along major transportation and infrastructure corridors in the state. DGGS is using these data to identify and evaluate geologic hazards such as slope instability, thaw settlement, and erosion in a corridor from Livengood to Valdez. In other areas, such as along the Alaska Highway between Delta Junction and the Canada border, lidar has been extremely useful in identifying previously unrecognized geologic hazards, especially in areas of heavy vegetation.



Lidar hillshade image in the Mount Hayes B-4 Quadrangle showing the Denali fault and an area of gelifluction, both of which are potential geologic hazards that may impact human activities. Inset map shows the areas for which lidar was collected in red; box denotes area that is being evaluated for potential geologic hazards under the current project.

In 2012, DGGS researched background information, prepared lidar-derived imagery for analysis, conducted an initial desktop hazard evaluation, and began entering preliminary interpretations into GIS. Initial lidar-based evaluations and GIS data will be field-checked during the 2013 summer field season, and supporting data will be collected to describe and quantify the nature and extent of identifiable geologic hazards. Interpretations and GIS data will be updated in fall 2013.

DGGS plans to complete a draft report that will be ready for peer review in early 2014. The report will consist of a folio of page-size map figures showing the identified geologic hazards and related landscape features on a lidar hillshade background. Each figure will be accompanied on the facing page by descriptions and/or extended discussions of the features mapped in the area depicted in the figure. This report will be useful for planning, infrastructure maintenance, and future construction in this important corridor.

This lidar assessment work is funded by the State of Alaska as part of a Capital Improvement Project (CIP).

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MAPTEACH

Alaska's Division of Geological & Geophysical Surveys (DGGS) is participating in the last year of MapTEACH (Mapping Technology Experiences with Alaska's Community Heritage), an education–outreach program that targets geospatial technology skills for rural Alaska students. This program is a continuation of what was originally a multi-year National Science Foundation-funded collaborative project led by DGGS and is now a part of the University of Alaska School of Natural Resources and Agricultural Sciences. MapTEACH emphasizes hands-on experience with spatial technology (GPS, GIS, Google Earth, and remote-sensing imagery in a local landscape–landform context) in conjunction with traditional activities. Working directly with geologists and local landscape experts, participants are presented with a chance to authentically emulate scientific data collection and mapping activities at a novice level, using real data in a real-world setting (fig.1).

Figure 1. Metlakatla middle school students collecting geologic data during a MapTEACH site visit to Annette Island in May 2012.

MapTEACH is founded on the integration of three focus areas: Geoscience, geospatial technology, and local landscape knowledge. Program materials are built on a menu-based model in which users (teachers) can select those portions of the curriculum that are most useful for their classroom objectives. When implementing the full range of MapTEACH curriculum, students and teachers interact in field settings with Native Elders, traditions-based community leaders, and professional geologists from DGGS and the University of Alaska. Introducing students to geoscience and geospatial technology in culturally responsive and stimulating classroom and field settings will enhance community understanding of landscape processes and natural hazards in rural Alaska. It will also foster appreciation of state-of-the-art technology tools and datasets that can be applied to informed community planning and decision making.

The MapTEACH training model includes multiple workshops and on-site training and classroom visits with participating teachers, as well as an updated and improved website that allows online access to curriculum materials (fig. 2). MapTEACH is currently working with the Yukon–Koyukuk school district and individual teacher-participants in Sleetmute, Hoonah, and Metlakatla, training teachers with diverse subject matter expertise in the use of the curriculum and resources, and preparing them to continue using MapTEACH in their classrooms after the project sunsets in 2013, the end of the current grant period.

MapTEACH is funded by the Alaska Department of Education and Early Development (EED) through an Alaska Native Education Program (ANEP) grant to the University of Alaska Fairbanks. Additional EED support was provided through Alaska Title II-A SEP Competitive grants to the Yukon–Koyukuk and Yukon Flats school districts.

Figure 2. The updated MapTEACH website (http://ww.mapteach.org) offers curriculum resources and other helpful information about the program to teachers wishing to explore place-based education in Alaska.

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QUATERNARY FAULT AND FOLD DATABASE

In 2012, the Alaska Division of Geological & Geophysical Surveys (DGGS) published a Quaternary fault and fold database compilation for Alaska (fig. 1) based on guidelines designed by the U.S. Geological Survey for the National Quaternary Fault and Fold Database. The Alaska database (DGGS MP 141) provides a single-source, accurate, user-friendly, reference-based fault inventory to the public and includes the first comprehensive GIS shapefile of Quaternary fault traces digitized from original sources, with metadata. Individual fault parameters such as slip rate, age of most recent rupture, dip direction, and others are catalogued in the database attribute tables. The database provides a valuable resource for the earthquake engineering community, insurance industry, scientific researchers, policy planners, and the general public.

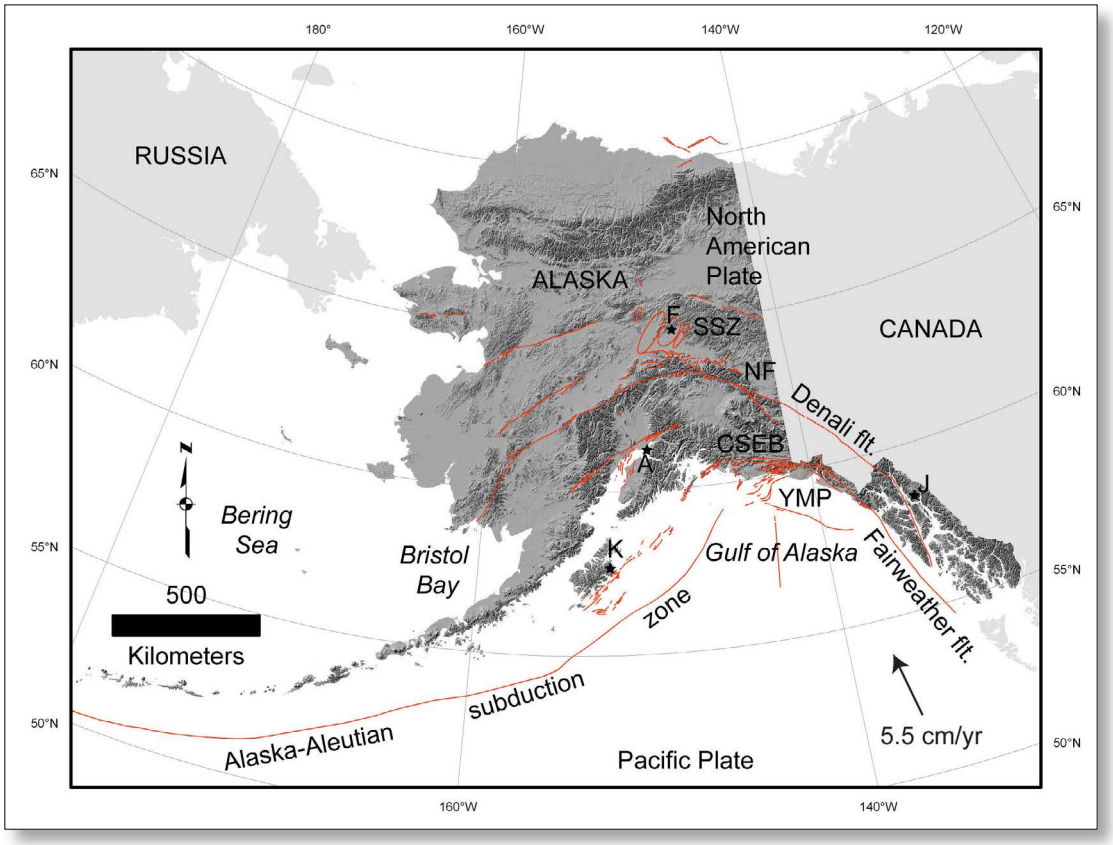

Figure 1. Quaternary faults and folds displayed on a shaded relief map of Alaska. Major cities shown by black stars. A, Anchorage; F, Fairbanks; J, Juneau; K, Kodiak; YMP, Yakutat microplate; CSEB, Chugach-Saint Elias fold and thrust belt; NF, Northern Foothills fold and thrust belt; SSZ, Salcha seismic zone.

DGGS is currently producing a printable map to accompany the database that will be publicly available for download for interested users. The map will depict Quaternary fault traces and crustal seismicity overlain on a hillshade map of the state. Faults will be color coded, based on the most recent age of activity, including historical (<150 yrs), post latest Wisconsin (<15,000 yrs), latest Quaternary (<130,000 yrs), mid-Quaternary (<750,000 yrs), and Quaternary (<1,800,000 yrs). The map will also include a table of significant historical earthquakes, selected photographs of surface ruptures, and an inset map depicting the distribution of pre-Quaternary faults. The inset map will communicate the concept that there are many unstudied faults in Alaska that may be Quaternary active. DGGS plans to release future updates of the database as new faults are discovered and existing faults become better characterized.

DGGS is currently seeking funding to produce text-based descriptions of individual structures. The text-based descriptions are an integral part of the U.S. Geological Survey's National Fault and Fold Database. Pertinent data to be summarized in these descriptions include geographic information, geomorphic expression, length, average strike, sense of movement, age of faulted surficial deposits, and summaries of paleoseismic studies. The ultimate goal is to link the text-based descriptions to individual faults in the database.

DGGS is also exploring options to display the database through an interactive web-map portal embedded on the DGGS website. The web-map application will present the database at the resolution of the original source maps and include basic map functions including identification and search tools, and multiple base map options such as topographic, satellite imagery, and hillshade maps.

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SURFICIAL-GEOLOGIC MAP OF THE SAGAVANIRKTOK AREA, NORTH SLOPE, ALASKA

The Alaska Division of Geological & Geophysical Surveys (DGGS) continues work on a project to map surficial geology at a scale of 1:63,360 for a 1,212-square-mile area that straddles the northern Brooks Range foothills between the Toolik and Ivishak rivers in the Sagavanirktok B-3, B-4, B-5, A-3, A-4, and A-5 quadrangles (fig. 1).

Many of the surficial deposits in the area are associated with latest Tertiary(?) to late Pleistocene glacial advances, with source areas in the Brooks Range. In southern and eastern portions of the map area younger glacial deposits with primary glacial morphology occupy lower elevations and valley bottoms (fig. 2a, Qgdi2/Qgfi2). Older glacial deposits (Qgdi1/Qgfi1) occupy higher elevations on valley walls and as a thin cover on bedrock hills. In contrast, northern and western portions of the map area are dominated by older glacial deposits with more subdued morphology. These areas are characterized by broad, low-relief surfaces extensively modified by gelifluction and thermorkarst processes with a thick cover of ice-rich silt or loess (fig. 2b).

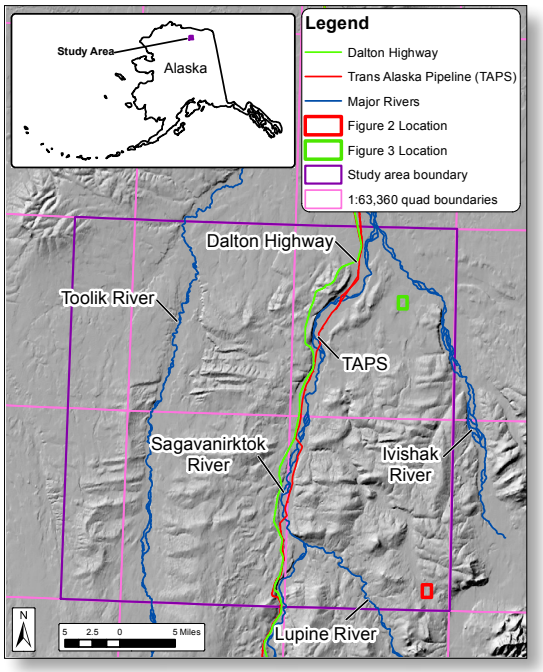

Figure 1. Location map of Sagavanirktok study area showing major drainages and infrastructure.

Completed maps will provide important information about geologic materials and potential geologic hazards such as thawing permafrost, slope instability, and flooding along the Trans-Alaska Pipeline System (TAPS) and Dalton Highway, the main artery for transportation to and from the North Slope. The maps will be a source of geologic information necessary for assessing landscape change and will be useful in evaluating the potential for future development such as resource exploration and a proposed natural gas pipeline. Draft maps are on schedule for peer review in early 2013, with final publication planned by the end of the year.

The Sagavanirktok surficial mapping project was conducted in conjunction with the DGGS Energy Resources Section as part of their ongoing work along the northern foothills of the Brooks Range. The project is funded by State of Alaska general funds.

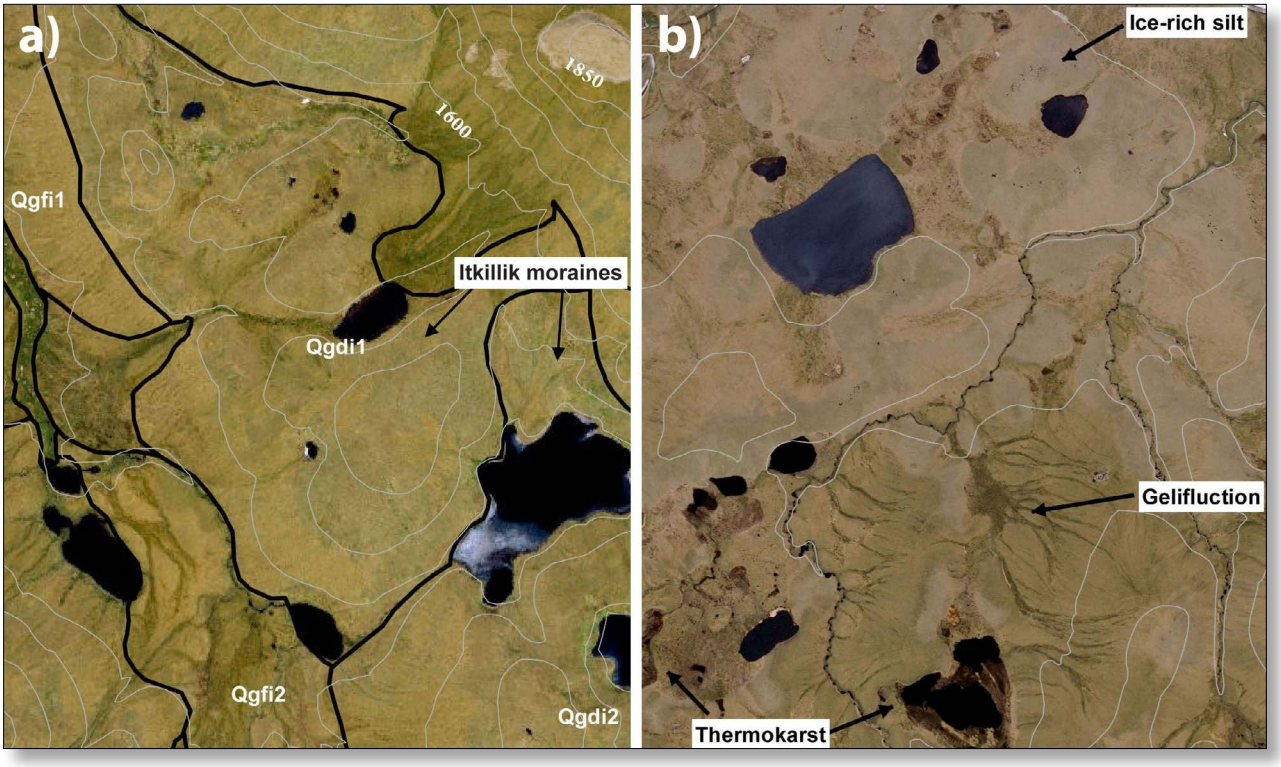

Figure 2. SPOT satellite images showing: (a) late Pleistocene age (Itkillik) moraines (Qgdi1, Qgdi2) and associated outwash (Qgfi1, Qgfi2) in the southern part of the map area, and (b) broad low-relief surfaces with extensive colluvial and periglacial deposits typical of northern portions of the map area.

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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, the Division of Geological & Geophysical Surveys (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 chosen and prioritized 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 and reports for the Kodiak area, Homer, Seldovia, Seward, and Whittier. A map and report for Valdez are in press as of this writing, and draft products for Chenega Bay have been submitted for publication. Modeling has been completed and maps and reports are in preparation for Sitka, Cordova, and Tatitlek.

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.

Team members have presented results of this program at international tsunami symposia in Seattle; Honolulu; Istanbul; Vienna; Melbourne; Hania, Greece; and Perugia, Italy; and at American Geophysical Union annual meetings in San Francisco. Locally, we have given presentations in the affected communities, in Dutch Harbor, and at the Association of Environmental & Engineering Geologists 2011 national meeting in Anchorage. In addition, this project has been the subject of articles in *Geotimes* and *TsuInfo Alert Newsletter*.

The town of Whittier, Alaska, which sustained severe damage from local submarine-landslide-generated waves during the 1964 great Alaska earthquake (Mw 9.2), resulting in 13 fatalities. Photograph by Gabriel Wolken.

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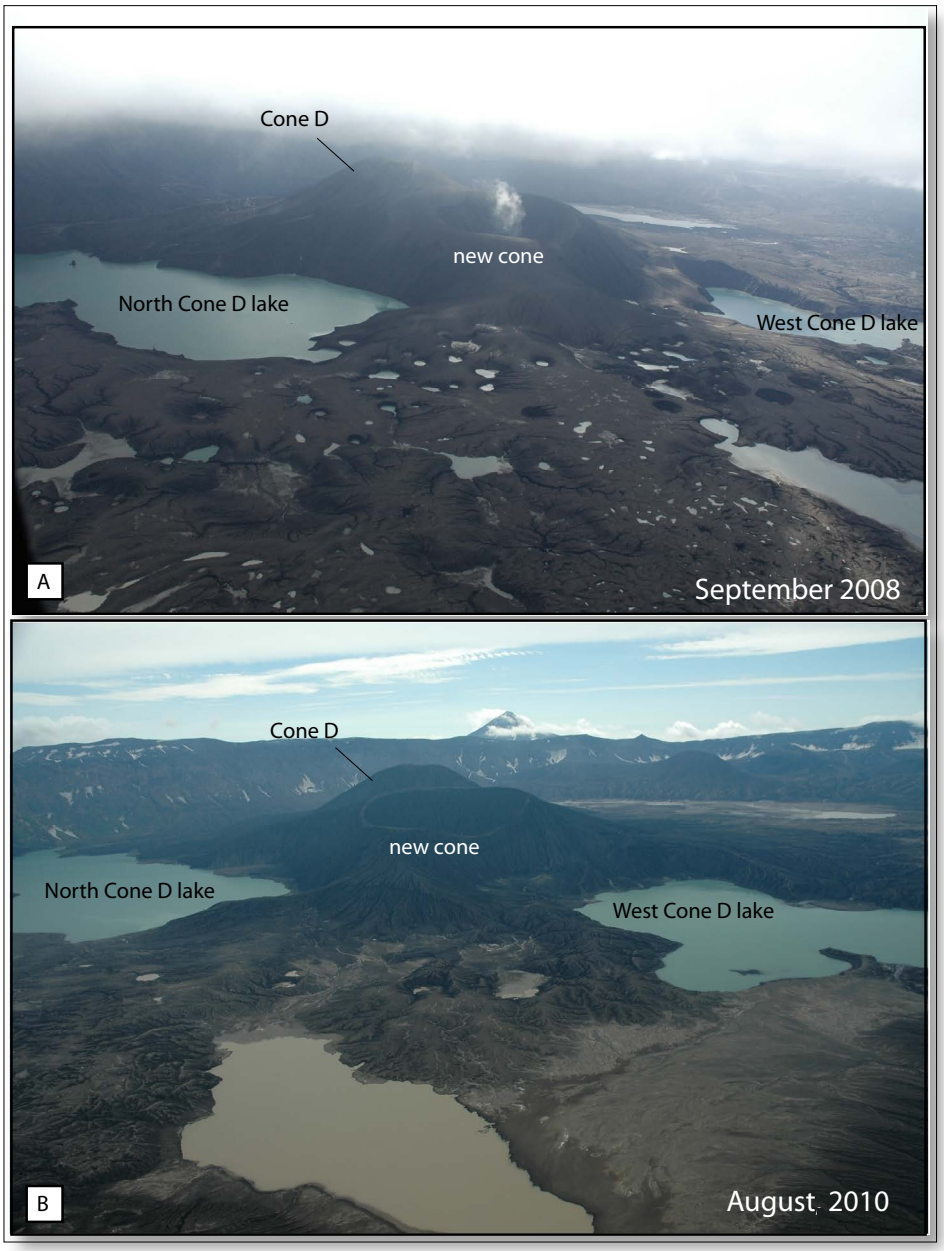
OKMOK VOLCANO: GEOMORPHOLOGY AND HYDROGEOLOGY OF THE 2008 PHREATOMAGMATIC ERUPTION

On July 12, 2008, with less than 5 hours of precursory seismic activity, the central Aleutian volcano Okmok erupted explosively, marking the beginning of a 5-week-long eruption that dramatically changed the morphology and groundwater system in the ten-km-wide caldera. The initial explosion sent an ash- and gas-rich column to 15 km above sea level. Early in the eruption, heavy rain mixed with new tephra on the flanks of the volcano, generating lahars (volcanic mudflows) that traveled across the upper slopes of the volcano and down all major drainages, creating large new deltas along the shoreline. For the next 5 weeks, eruption intensity waxed and waned with explosions occurring from multiple vents on the caldera floor as rising magma interacted with shallow groundwater. One crater formed next to, and eventually captured and drained, the largest pre-existing caldera lake (total volume drained was 13.6 million cubic meters). As the eruption subsided, coalescing maar and collapse craters eventually filled with water, forming a new lake west of cone D and dramatically changing the morphology and volume of the old lake. The longest-lived vent formed a new tuff cone about ~275 m tall and ~1.5 km wide on the western flank of pre-existing cone D. This new tuff cone, the new lakes and collapse pits, and the accumulation of many tens of meters of fine-grained tephra have significantly altered the Okmok landscape. This eruption was substantially larger than any Okmok eruption since that of 1817 (which destroyed the then-unoccupied village of Egorkovskoe on the north coast of Umnak) and far larger than the eruptions of 1945, 1958, or 1997.



Division of Geological & Geophysical Surveys (DGGS) geologist Janet Schaefer, along with Alaska Volcano Observatory (AVO) lead author Jessica Larsen (University of Alaska Fairbanks Geophysical Institute) and colleague Tina Neal (U.S. Geological Survey), are writing a DGGS Report of Investigations documenting this fascinating eruption. Fieldwork focused on the stratigraphy and sedimentology of the tephra deposits from the 2008 eruption, documentation and description of vent evolution, a revision of the hazard assessment, creation of a post-eruptive geologic map, and acquisition of surveyed GPS points for digital elevation model (DEM) creation. The new post-eruption DEM of the caldera was published in 2011 (DGGS RDF 2011-6) and has aided significantly in quantifying the geomorphic changes in the caldera (fig. 1). Anticipated release of the Report of Investigations detailing the eruption is spring 2013.

Figure 1. Oblique aerial photographs of the newly expanded north Cone D lake, the new cone, and a new lake west of cone D; region of collapse pits in the middle ground. A) Photograph from September 2008 looking south. B) Photograph from August 2010 showing enlarged lakes and subdued field of collapse craters. Photographs by J. Larsen (UAF/GI).

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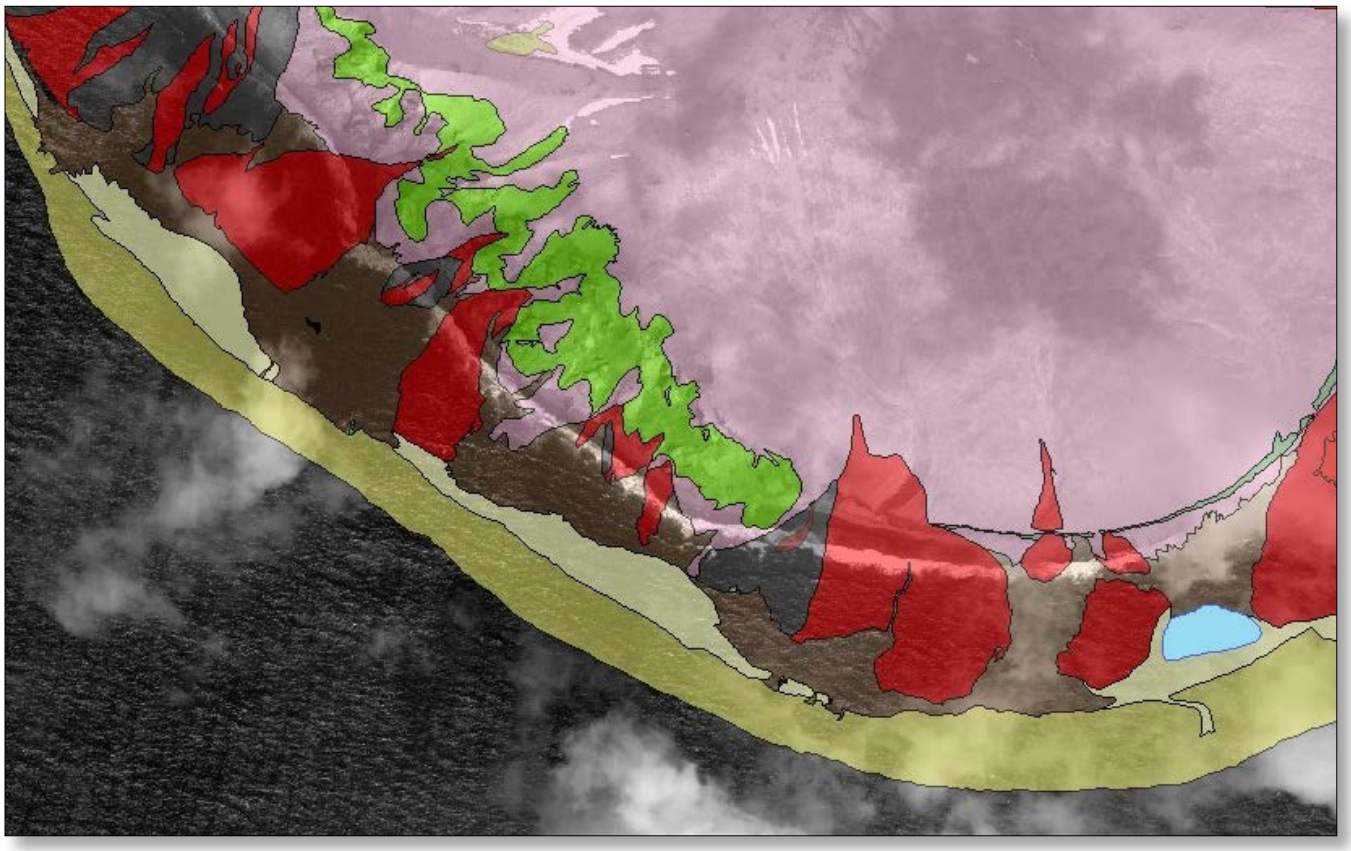
KASATOCHI VOLCANO: GEOLOGIC MAPPING AND VOLCANOLOGICAL STUDIES

Kasatochi is a 2.7-square-mile island volcano midway between Atka and Adak, in the Aleutian Islands. It provides nesting territory for several hundred thousand seabirds, is one of the largest sea lion rookeries in the Aleutians, and has been closely studied by the U.S. Fish and Wildlife Service (USFWS) and other biologists for decades. In August of 2008 Kasatochi erupted for the first time in written history. The eruption was about a thousand times more energetic than any other Alaska eruption in nearly a century. During the day-long eruption, the area of the island increased by 40 percent, the area enclosed by the crater rim increased by 30 percent, the crater lake grew by 70 percent, and pyroclastic deposits completely covered seabird nesting crevices. A multi-agency and multi-disciplinary group quickly assembled, attracted to the rare opportunity to study the regrowth of an ecosystem that had been nearly obliterated. The study has been funded by the North Pacific Research Board, USGS, USFWS, and the Alaska Volcano Observatory (AVO). Prior to the eruption, the geology was virtually unknown. As an AVO partner organization, the Division of Geological & Geophysical Surveys (DGGS) is leading the effort to produce the first-ever geologic map of Kasatochi as part of the ecosystem recovery project, and as a lead-in to volcanologic and petrologic studies. Fieldwork has been based off the USFWS refuge ship Tiglax on 2- to 3-day trips twice each summer starting in 2009, although winds and waves that precluded landing a skiff on the island have resulted in dramatically reduced on-island time on some of the trips. To date, roughly 100 rock samples have been collected and analyzed chemically and petrographically. These data and field mapping serve to distinguish several major pre-2008 rock units. Additionally, 3,500 mineral analyses have been collected from a stratigraphically and compositionally representative subset of samples. The mineral analyses provide important information about complex petrogenetic (rock-forming) processes. The 2008 eruption, probably because it was so energetic, brought to the surface many nodules of cumulate, zero-age, gabbroic “crystal mush”. Such nodules are unusual (though not unique) and, as the solid residue of petrogenesis, provide important additional constraints on processes governing the genesis of magmas. DGGS expects to publish the new geologic map of Kasatochi in late 2013.



The southwest portion of Kasatochi Island. Major units identified in current mapping are shown on top of a pre-eruption satellite image. The green units are pre-2008 deposits. Yellows are new beaches, and pink, red, tan and gray are unmodified or reworked 2008 deposits. The pre-eruption shoreline is marked by a line of white surf, which approximately underlies the seaward edge of the pink unit. The entire scene is about 1 km from east to west.

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CHIGINAGAK VOLCANO: GEOLOGIC MAPPING AND HAZARD ASSESSMENT

Mount Chiginagak is a hydrothermally active volcano on the Alaska Peninsula, approximately 170 km south–southwest of King Salmon. This small stratovolcano, approximately 8 km in diameter, has erupted through Tertiary to Permian sedimentary and igneous rocks. Intermittent geologic fieldwork since 2005 has consisted of lava-sample collection for radiometric dating and geochemical analysis, mapping of Holocene lava flows, lahars, and debris avalanches, and the collection and stratigraphic description of tephra deposits.

Pleistocene pyroclastic flows and block-and-ash flows, interlayered with andesitic lava flows, dominate the edifice rocks on the northern and western flanks (fig. 1, Unit Pba). The oldest rocks dated (~250,000 years old) are lava bombs in a cliff-forming pyroclastic flow deposit on the northwestern flank. Pleistocene porphyritic lava flows range in composition from 54.2 to 62.7 weight percent silica (SiO_2) and contain variable proportions of plagioclase, hypersthene, and augite.

Our mapping indicates that Holocene activity consists primarily of debris avalanches, lahars, and lava flows; explosive activity resulting in proximal tephra fall is less prevalent. Terrace deposits of lahars and debris avalanches appear along a creek draining the southeastern flank toward the Pacific Ocean (fig. 1, Unit Hdl) and in upper Indecision Creek below the toe of the south flank glacier. Holocene lava flows (Unit Hl, fig. 1) cover Pleistocene lavas on the northeastern flank and range in composition between 55.9 and 57.5 weight percent SiO_2. Holocene block-and-ash flow and pyroclastic flow deposits extend almost 8 km from the summit, down a valley on the southeastern flank (fig. 1, Units Hba and Hp; and fig. 2). Proximal tephra collected during recent fieldwork suggests there may have been limited Holocene explosive activity that resulted in localized ash fall. Lake sediment from Mother Goose Lake has preserved as many as 50 tephras deposited within the last ~3800 years, some presumably from Chiginagak volcano (fig. 2). Samples of these tephras are currently being prepared for microprobe analysis to determine source vents.

A geologic map is scheduled to be published in 2013, followed by a hazard assessment report in 2014.

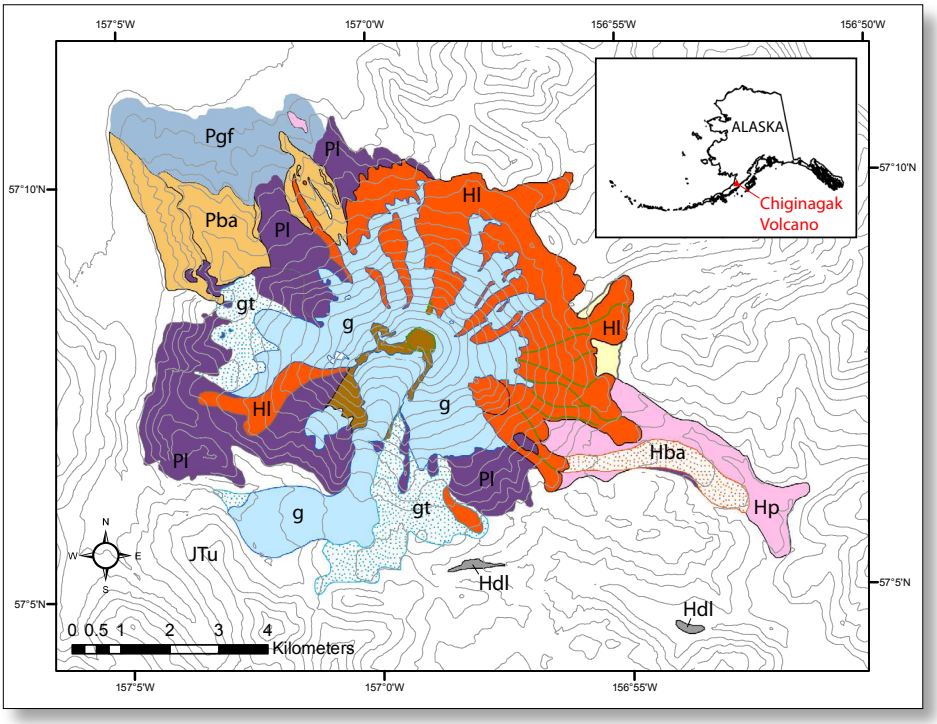

Figure 1. Generalized geologic map of Chiginagak volcano showing major undifferentiated deposits of Pleistocene lavas (Pl), Pleistocene block-and-ash flow deposits interlayered with andesite lavas (Pba), undifferentiated glaciofluvial and glaciolacustrine deposits (Pgf), Holocene lavas (Hl), Holocene block-and-ash flow deposits (Hba), Holocene pyroclastic flow deposits (Hp), Holocene debris avalanche and lahar deposits (Hdl), glaciers and perennial snow fields (g), and glacial till (gt). Pending $^{40}Ar/^{39}Ar$ age determinations and geochemical analyses will help differentiate these major depositional units. Unit JTu refers to undifferentiated bedrock (Tertiary to Permian rocks mapped by Detterman and others, 1987).

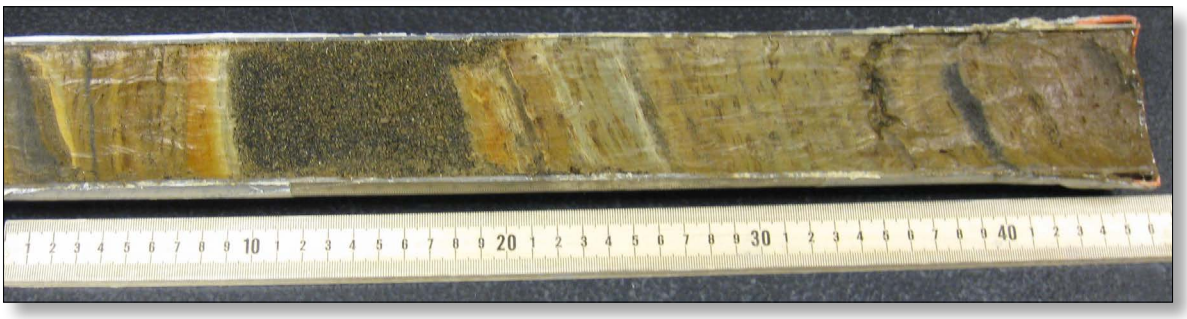

Figure 2. Photo of a section of Mother Goose Lake sediment core. Tephra layers appear as dark bands across the core.

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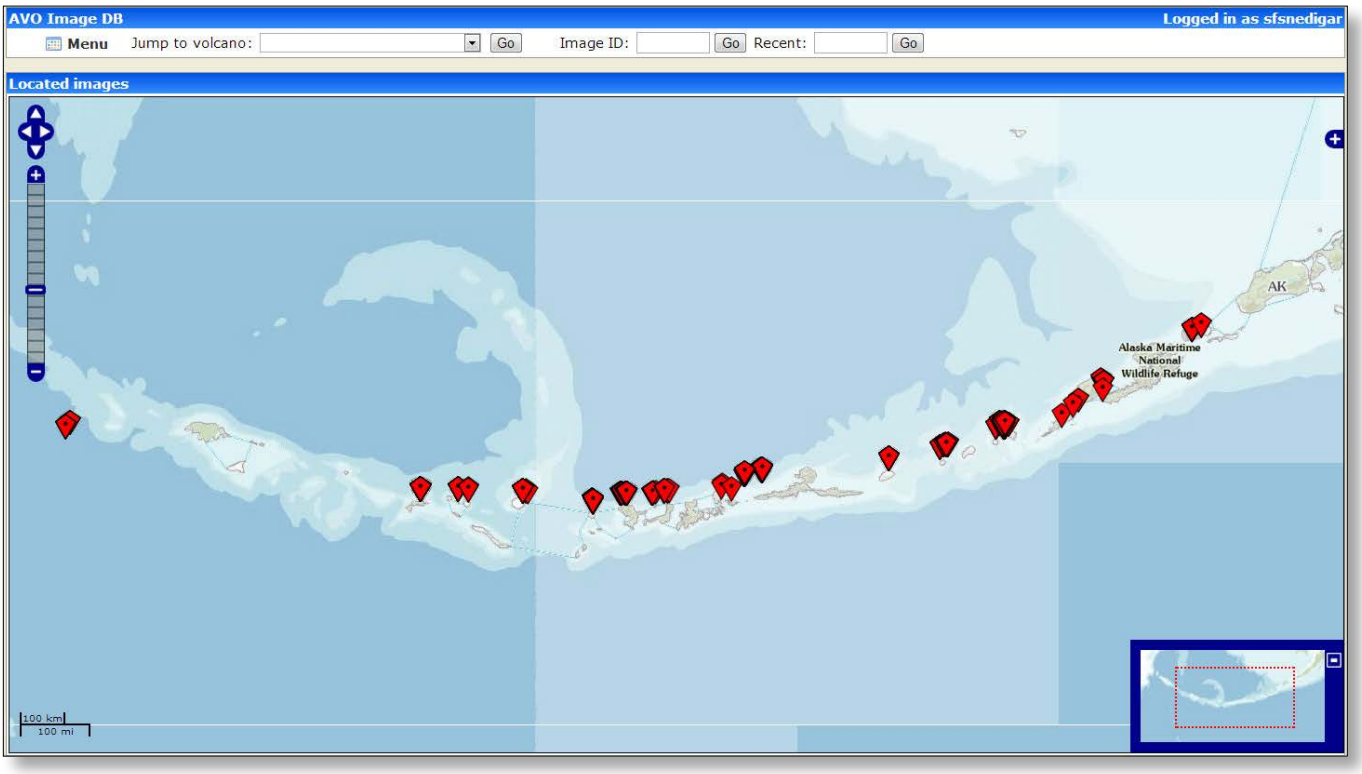
ALASKA VOLCANO OBSERVATORY (AVO) WEBSITE AND DATABASE



The image database contains this map, which shows the location of images that have been tagged with latitude and longitude coordinates.

The AVO public website (http://www.avo.alaska.edu) serves about 6,000,000 pages and approximately 300 gigabytes of data to well over 100,000 unique visitors per month, and is among the top ten most-visited U.S. Geological Survey (USGS) and USGS-affiliated websites in the country. It continues to be the most complete single resource on Quaternary volcanism in Alaska. The Division of Geological & Geophysical Surveys (DGGS) was the original creator of the AVO website in 1994, and continues to be the site designer, builder, and manager. The website is dynamically driven by the Geologic Database of Information on Volcanoes in Alaska (GeoDIVA).

Images are a major part of the content on the AVO website. The image module within GeoDIVA currently stores about 20,000 images, ~6,000 of which are publicly viewable. This year, we are re-writing the image database software. The new version will take advantage of the metadata provided by digital cameras – such as date and time, latitude, longitude, elevation, and zoom level. These data are automatically read from the image file, and inserted into queryable fields of the database, enabling faster and more accurate image upload.

The image database also provides an interface where administrators review images for content and captions before they are accessible from the public web page. Administrators can also upload pictures to AVO's Twitter account and, eventually, to an AVO Facebook page.

In other continued database maintenance and development, the database now also holds ~10,700 sample records, ~5,600 of which have geochemical analyses, and about 4,700 references. Eruption histories are also continually updated.

DGGS/AVO is on the leading edge of web and database development for volcano observatories, and portions of DGGS-written database software have been installed at other U.S. volcano observatories. 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 maintain our focus on continual incremental improvements to the site, and serving new database modules as they become available.

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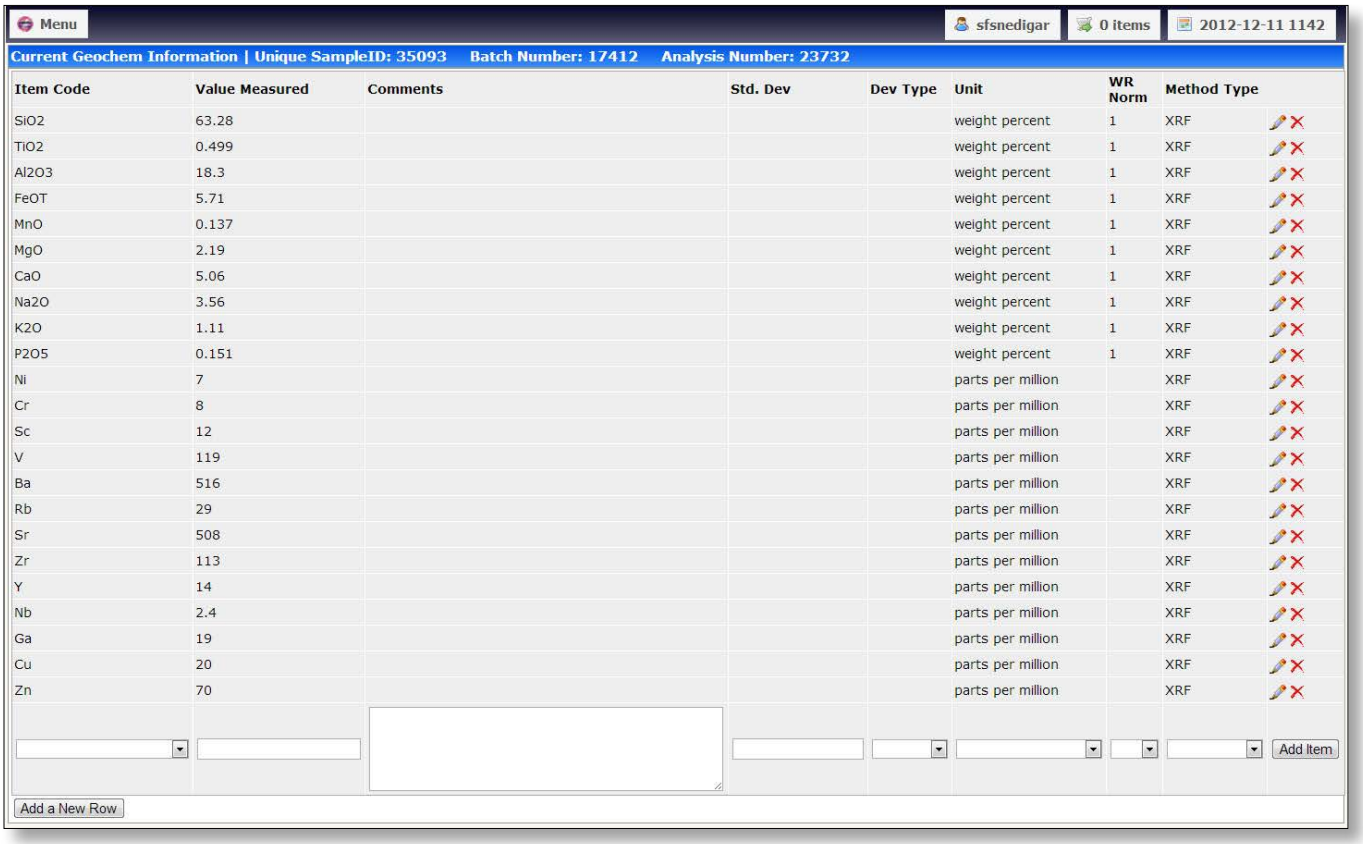
QUATERNARY VOLCANO GEOCHEMICAL DATABASE

As part of the Division of Geological & Geophysical Survey's (DGGS) ongoing development of the Geological Database of Information on Volcanoes in Alaska (GeoDIVA), DGGS/AVO staff have created a database structure to hold geochemical data on Quaternary volcanic rocks in Alaska. Published data is available to the public through AVO website (http://www.avo.alaska.edu), and searchable by map, volcano, sample metadata information, or analysis types. Unpublished data will also be available internally to AVO users, if the data owner has granted explicit permission.

Currently, only whole-rock major- and trace-element values and metadata are being uploaded to the database, although the system is designed to accommodate other types of data such as mineral, glass, or fluid geochemistry, and intended to be compatible with other major geochemical database efforts such as EarthChem. We are making every effort to provide the best data possible for each sample and analysis, which often entails additional actions such as tracking down obscure references and untangling multiple sample numbers for the same sample. In addition, DGGS and Washington State University (WSU) GeoAnalytical Laboratory staff have re-reduced the thousands of samples analyzed by WSU over the past 25 years using the same inductively coupled plasma mass spectrometry (ICP-MS) calibration in order to maximize internal consistency of the data.

This database will be a valuable research tool for geoscientists with interests ranging from volcano-specific processes to whole-arc data synthesis. Because the database is an intrinsic part of GeoDIVA, it will also help consolidate all of Alaska's volcano information in one place. The database currently holds about 10,900 sample records, and 5,853 have geochemical data entered. All known published whole-rock major- and trace-element analyses for Quaternary volcanic rock samples in Alaska have been uploaded to the database. We are nearly finished with a quality-assurance check of the data, and the published analyses are available on the public website via the individual volcano pages.

In this next year, we plan to refine our search and output tools. We are determining the best way to query and display our multi-dimensional data (sample, value, analyte, method, citation, etc.) in a two-dimensional spreadsheet that preserves the user's ability to manipulate numeric values. As with all GeoDIVA modules, geochemical data will be updated as the AVO community produces more data.



Web-based tool for adjusting individual analytes or values for an existing analysis in the database - an essential ability for quality control.

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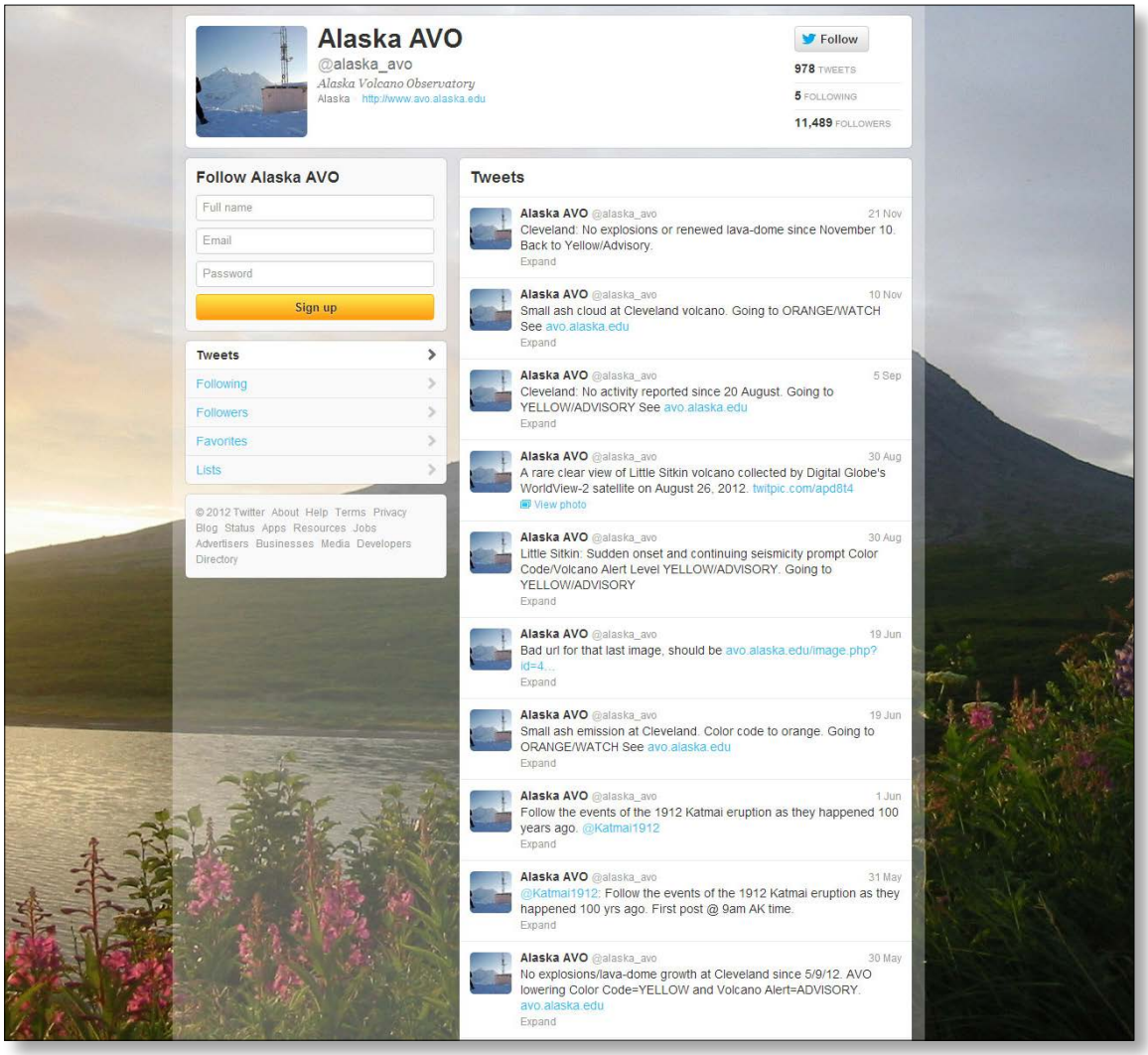
ALASKA VOLCANO OBSERVATORY (AVO) SOCIAL MEDIA

AVO has three primary objectives: (1) to conduct monitoring and other scientific investigations in order to assess the nature, timing, and likelihood of volcanic activity; (2) to assess volcanic hazards associated with anticipated activity, including kinds of events, their effects, and areas at risk; and (3) to provide timely and accurate information on volcanic hazards and warnings of impending dangerous activity to local, state, and federal officials and the public. As an AVO partner, and in support of the third primary objective, the Division of Geological & Geophysical Surveys' (DGGS) Volcanology Section is working toward using social media such as Twitter and Facebook to reach a larger and more diverse audience than our current website, fax, and email protocols provide.

Since the 2009 eruption of Redoubt, AVO has had a presence on Twitter. This account has evolved over the past couple of years and now entails our use of Twitter's application programming interface (API). The Hazard Alert Notification System (HANS) automatically "tweets" a portion of any Volcanic Activity Notification, with a link to the full text. We have received very positive feedback from our use of Twitter, and have been reviewing other hazard-monitoring agencies' uses of social media (e.g., the National Weather Service). Because of the Twitter success, and with encouragement from members of the public and emergency managers, we plan to create a Facebook account that also uses an API, to auto-publish our updates. In addition, both APIs could be automated to easily post administrator-reviewed images to the accounts.

We believe social media can be an excellent tool to provide rapid communication to our diverse user base, as long as the information we post to social media (1) is not different from what we post in our formal notices, (2) continues to provide a link to full and complete information (rather than being an informational dead end), and (3) does not require unreasonable staff time for monitoring and maintenance.



AVO's Twitter page (http://twitter.com/alaska_avo) displays bits of information from the latest information releases as well as figures and images of note. Currently there are more than 11,000 individual users following the account.

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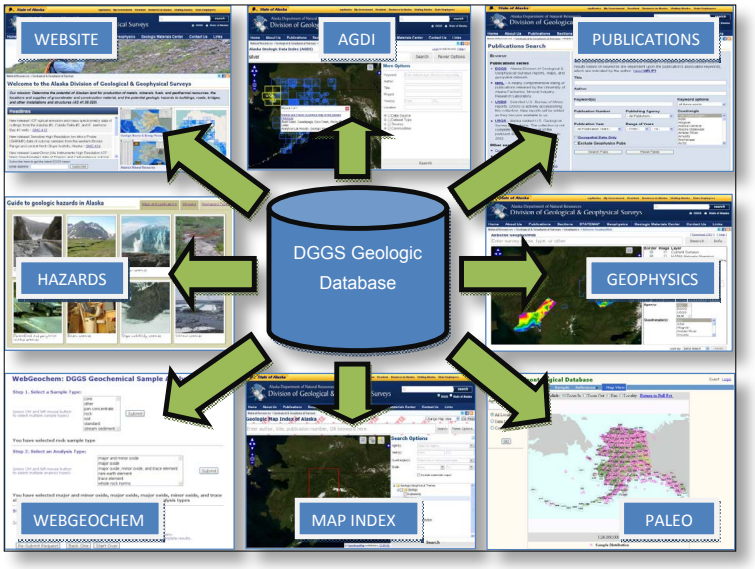
WEBSITE DEVELOPMENT AND DIGITAL GEOLOGIC DATABASE

The Division of Geological & Geophysical Surveys' (DGGS) website (http://ww.dggs.alaska.gov) allows users to search, view, and download DGGS publications and associated digital data. DGGS has become the leading Alaska geology-related database agency and a trusted online repository of geologic publications and data. In addition to DGGS publications, our online library includes an extensive collection of scanned reports and maps produced by other geoscience agencies, including the U.S. Geological Survey, UAF Mineral Industry Research Lab, and U.S. Bureau of Mines. DGGS's site also provides easy access to its geophysical data, geochemical data, information about its Geologic Materials Center, an online Guide to Geologic Hazards in Alaska, the Alaska Geologic Data Index (a database of industry reports and maps, field notes, drill logs, and other unpublished geology-related data), descriptions of the division's projects and special studies, annual reports from previous years, and other topics of interest.



Over the past decade, DGGS has transformed its website from a few static HTML pages into an informative, database-driven content management system that is now the division's primary means to announce and distribute geological and geophysical publications and information. The volume of files and information provided by the DGGS website has grown exponentially. To facilitate website growth and support the public's need for expedient access to a multitude of geologic data sources, our focus for 2012 has been to increase efficiency by optimizing site performance, standardizing our digital data releases, and to better integrate the website with data stored in our geologic database.

The DGGS geologic database system includes data identification and retrieval functions that guide and encourage users to access geologic data online. Development of this database was initiated as part of the federally funded Minerals Data and Information Rescue in Alaska (MDIRA) program in 2000; ongoing data input, use, and maintenance of the database system are now an integral part of DGGS's operations supported by State general funds.

Since 2000, the database and website team has established a secure and stable enterprise database structure, loaded data into the database, and created multiple web-based user interfaces. During 2012, the team continued progress on various projects requiring database and web application support: Alaska Geologic Data Index (page 68), Geologic Map Index of Alaska (page 67), Alaska Paleontology Database (page 67), Airborne GeophysWeb (page 42), and Guide to Geologic Hazards in Alaska. Also, we manage ongoing additions of geochemistry data to Webgeochem, and Alaska-related U.S. Bureau of Mines and U.S. Geological Survey publications to the publications search, as well as maintenance of existing applications. Over the coming years, DGGS will continue to expand its repository of geologic data and strive to meet public demand for technologically advanced, easy-to-use, online data delivery systems.

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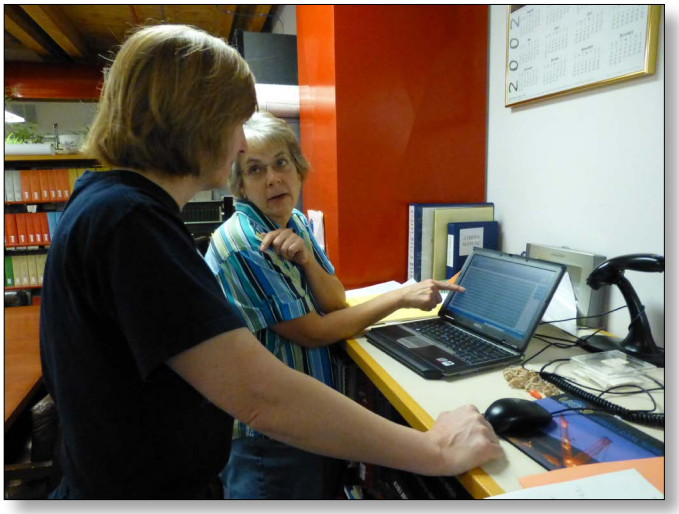
PUBLICATIONS AND OUTREACH PROJECT

The Publications and Outreach Project publishes and distributes geologic data that has been collected, analyzed, and assembled by geologists in DGGS's Minerals, Energy, Engineering Geology, and Volcanology sections and Geologic Materials Center (GMC). Some of the functions carried out under this project are:

- Design, digitally assemble, edit, and oversee final production of technical and educational geologic maps, reports, and informational publications in printed and digital formats.
- Prepare an annual report, with articles written by division staff, describing DGGS projects and activities, announcing new products, and relating plans for future projects.
- Publish newsletters to summarize DGGS's progress and announce new publications.
- Prepare displays and represent the division at geologic conferences and meetings by providing staff and assembling and transporting the display booth.
- Staff full-time geologic information center in Fairbanks, providing data about Alaska's geologic resources and hazards through DGGS's publications, geoscience specialists, and other resources. Sell and distribute printed and online geologic reports, maps, and digital data.
- Assist staff in writing, then review and ensure completeness and accuracy of metadata for each digital project and file in its appropriate online repository.
- Manage DGGS's reference library so that reports, maps, and other data are available, and publications are on hand that geologists need to prepare geologic products.
- Maintain as complete a collection as possible of Alaska-related geoscience publications produced by the U.S. Geological Survey, the former U.S. Bureau of Mines, the U.S. Bureau of Land Management, and the UAF Mineral Industry Research Laboratory; collect and maintain other Alaska-related publications as needed.



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 or greater) 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: ◆ annotated bibliography in support of Northwest coastal community hazard planning (includes 21 communities) ◆ fossil fuel and geothermal energy sources for local use in Alaska (includes 12 regions) ◆ Alaska Geologic Data Index, which includes information about industry reports and maps, field notes, drill logs, and other unpublished geology-related data ◆ surficial, engineering-geologic, and reconnaissance maps of the Alaska Highway corridor, Tetlin Junction to Canada border ◆ active and potentially active faults along the Alaska Highway corridor, Tetlin Junction to the Canada border ◆ ash fall contour map of the 2009 eruption of Redoubt Volcano, including digital shapefiles of contours and sample locations ◆ spatially referenced oblique aerial photography of Eastern Norton Sound and Golovin shorelines ◆ migrated hydrocarbons in exposure of Maastrichtian nonmarine strata near Saddle Mountain, lower Cook Inlet ◆ coastal hazards field investigations in response to the November 2011 Bering Sea storm, Norton Sound ◆ digital elevation model of Sitka Harbor and the city of Sitka ◆ updated map of Alaska's mineral resources ◆ geologic basins and energy resources of Alaska ◆ a report on Alaska's Mineral Industry 2011 – exploration activity; and ◆ a digital database of Quaternary faults and folds in Alaska.

Publications are available in paper format (plotted as needed and sold for the cost of printing) and as digital PDF documents and scanned, compressed maps on the DGGS website (available for download at no charge). An increasing number of GIS digital datasets are available on the DGGS website, along with the maps and other images that DGGS has produced with those datasets. Having the geospatial data available allows our users to download the data and customize its use to their needs. 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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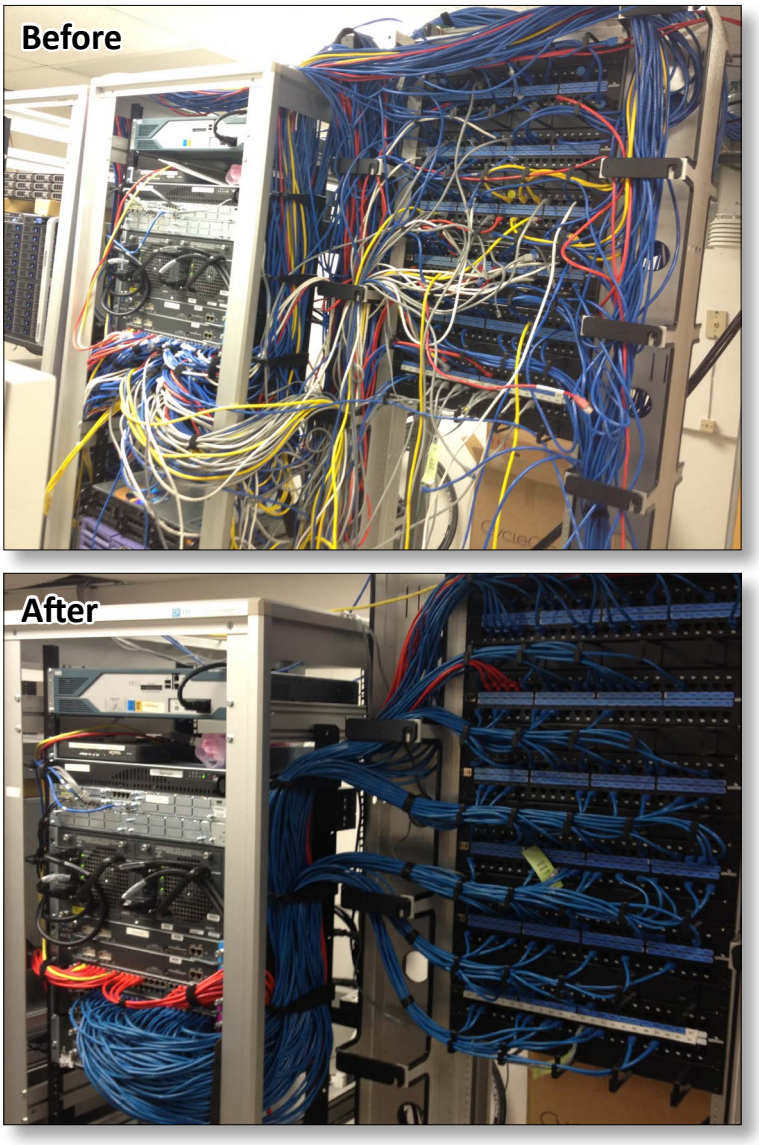
INFORMATION TECHNOLOGY (IT) INFRASTRUCTURE PROJECT

The Division of Geological & Geophysical Surveys' (DGGS) Information Technology group significantly upgraded server and other IT architecture during the past year. Aging hard drives in the primary file server were replaced and now provide 33 terabytes (TB) more storage and archive space for geologic data. DGGS's Oracle database software was upgraded to current standards, allowing the use of DNR's Oracle database performance monitoring system. DGGS IT staff in Fairbanks and DNR IT staff in Anchorage can now proactively manage any database issues before they create downtime.



New cabling infrastructure makes server maintenance significantly faster and more reliable.

Backups, disaster recovery, and physical data distribution continue to be an important part of daily IT tasks. DGGS is unique within DNR in that all desktop and laptop computers are backed up. While most staff members utilize server-based storage and keep very little data on their desktop machines, the files that remain on user machines are still important and often irreplaceable. Newly released open-source software allowed IT staff to change the configuration of the drive arrays on the backup servers, reducing the amount of processing time required by daily, weekly, and monthly backups by 50 percent. Automated systems run daily backups after hours so that changes during the day are incorporated into the backups at night. The primary backup server, used for backing up all UNIX and Windows servers, is now a single RAID5 84-TB volume. The server used for backing up Windows-based desktop and laptop computers is a single RAID5 30-TB volume. The offsite backup server, used to store only the most recent copy of any backup, is a RAID5 26-TB volume.

The IT group also configured a new server to display electronic maps. Part of this server will be used to provide Internet users an easy way to quickly see where a publication is located or what coverage a map provides. Because these "thumbnail maps" use existing GIS shapefiles, very little additional development is required to add them to DGGS's website. A proof-of-concept thumbnail map can be viewed at http://dggs.alaska.gov/pubs/id/24264. An additional part of this mapping server is used to display the Alaska Geologic Data Index, a public interface to unpublished geologic data (see page 68), and Airborne GeophysWeb, an interface to airborne geophysical data (see page 42).

IT staff continued standard in-house support, including new software installation, upgrading end-of-life hardware, tracking inventory, and responding to hardware issues. DGGS's social media sites, Twitter (http://www.twitter.com/akdggs) and Facebook "fan" page (http://www.facebook.com/akdggs), promoted new publication releases, news, and announcements. DGGS also continued a cooperative agreement with the University of Alaska Fairbanks (UAF) to physically host part of the Alaska Volcano Observatory (AVO) web server infrastructure in DGGS's server room while its Internet connectivity remains through UAF.

Future plans include decommissioning the only remaining Sun server, upgrading and reconfiguring our web server infrastructure by adding a caching front-end interface, adding an ESRI ArcSDE cluster to communicate between our map server and our databases, and adding another equipment rack in our server room for expanding server infrastructure.

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FIELD MAPPING TECHNOLOGY PROJECT

The Alaska Division of Geological & Geophysical Surveys (DGGS) collects, analyzes, and publishes geological and geophysical information toward its mandate to inventory and manage Alaska's natural resources and evaluate geologic hazards. DGGS collects a large amount of new data each year and synthesizes the data into multiple reports and maps for publication. On average, DGGS conducts seven field projects per year, each with teams of five geologists in the field for three weeks, or 735 person-days in the field. Each geologist records detailed observations at an average of 25 locations per day in a notebook or on a paper map, which amounts to more than 18,000 multi-part parcels of data per year that must be hand recorded and then translated and parsed into digital media for analysis and eventual publication.

DGGS is committed to the timely release of data to the public and prompt fulfillment of obligations to funding sources. In 2005, DGGS began investigating the potential of using digital field mapping technology to streamline data collection and processing. Digital mapping is defined as using a computer or personal digital assistant (PDA) to display and record information that has traditionally been recorded on paper, whether on note cards, in a notebook, or on a map. Computer technology and software are now becoming portable and powerful enough to take on some of the burden of the more mundane tasks a geologist must perform in the field, such as obtaining precise locations, plotting structural data, and color coding physical characteristics of a rock. Additionally, computers can now perform some tasks that were formerly difficult in the field, for example, recording text or voice digitally and annotating photographs on the spot. The greatest benefit of digital mapping is a decrease in the amount of time necessary for data entry, thereby potentially increasing the amount and quality of information that can be recorded during a field day.

In 2012, the Ray Mountains Strategic and Critical Minerals Assessment project (see page 38) was challenged to repetitively collect rock, stream-sediment, and pan-concentrate samples and structural data over a 3,500-square-mile area. Project geologists determined that field computers would best facilitate collecting information that was consistent among field personnel and help keep field plans up-to-date as the project progressed. The project rented a Trimble TSC3 handheld field computer for each geologist. Prior to field work, a series of data-entry forms that resembled the paper field cards staff had used in the past were customized with ESRI ArcPad/ArcPad Studio mobile GIS data collection software. Geologists filled out the forms throughout the day and, in the field office, synchronized their handheld computers with a master geodatabase that kept a running record of all samples and supporting data. Once the master was complete, the files were loaded back onto the field computers so the geologists could use them for field reference the next day. The devices also helped with navigation and allowed geologists to overlay their data on digital geologic and geophysical maps, facilitating real-time interpretation. Although there were some problems with synchronization that had to be resolved, field personnel were generally happy with the methodology and data collectors. DGGS anticipates developing an enterprise GIS-database structure that will support and expand future uses of field technology.

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GEOGRAPHIC INFORMATION SYSTEM (GIS) PROJECTS

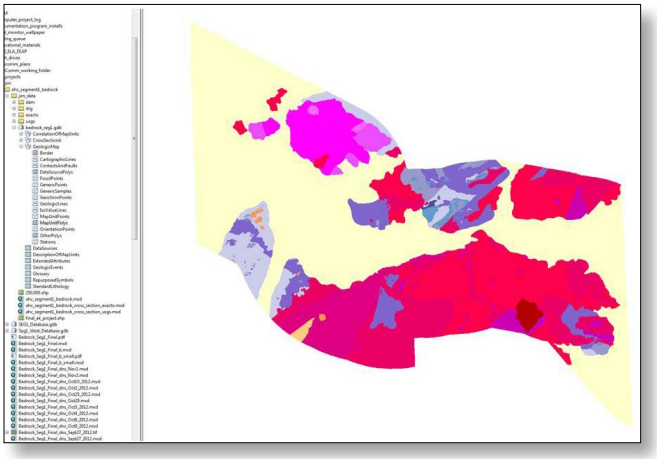
The GIS projects underway at the Division of Geological & Geophysical Surveys (DGGS) are designed to take advantage of recent advancements in geospatial tools, and to present DGGS's geospatial data in multiple ways, making the data more accessible and easier for users to view, acquire, and use.

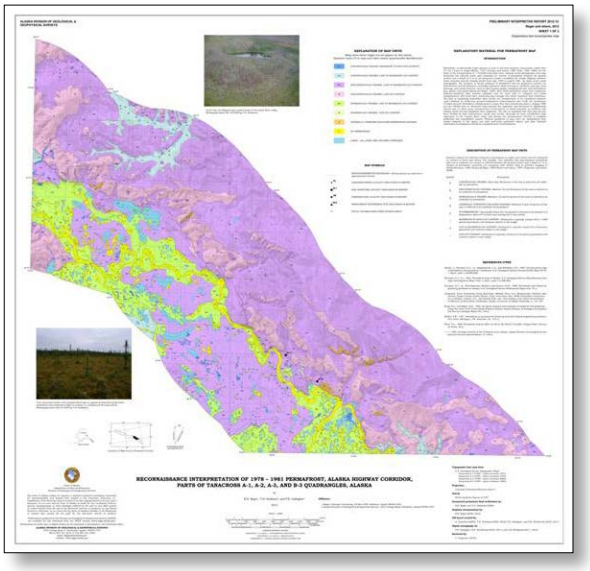
WEB MAP APPLICATIONS

DGGS is beginning to design web-map applications for internal and public use. A web map is an Internet-based, interactive map application that allows the user to display and query the layers on the map. A web map contains one or more *ArcGIS for Server*® map services. A prototype of the new application can be viewed at http://www.dggs.alaska.gov/pubs/id/24264.

USGS National Cooperative Geologic Mapping Program (NCGMP) Geodatabase

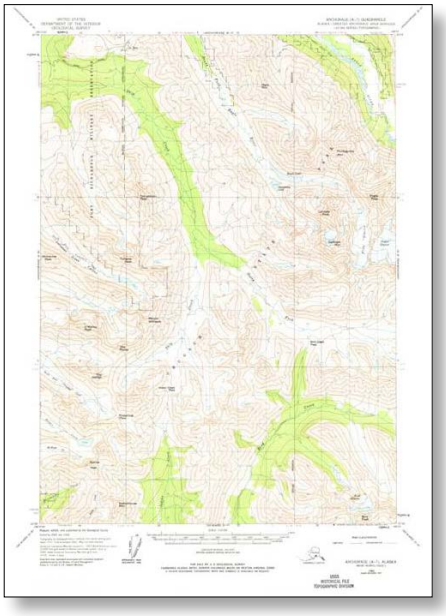
DGGS is implementing a division-wide, standardized geodatabase model based on the U.S. Geological Survey (USGS) NCGMP (http://ncgmp.usgs.gov/) format. The NCGMP is a proposed standard for digital publication of geologic maps that are funded by the USGS under the STATEMAP program. Instituting a division-wide geodatabase has several benefits, including standardizing the data's content, attributes, naming conventions, and other pertinent information required for archiving and disseminating geologic map data. A standardized geodatabase is instrumental in creating future web map applications and streamlining the metadata creation process.





DGGS Geologic Mapping Template

DGGS has finalized and is utilizing a geologic mapping template for use by the division's GIS/cartographic staff. The benefit of instituting a division-wide template is to standardize the design layouts while streamlining the process used to create geologic maps, thereby making them available to the public in a more timely manner.



Historical U.S. Geological Survey Topographic Map Inventory and Archive

DGGS has nearly completed the inventorying and archiving of its collection of historical USGS topographic maps. A database was created based on the publication dates of the maps. A retired DGGS employee currently volunteers time as the project manager for creating and populating the inventory database. These maps are available for use by DGGS staff and inspection by the public. They contain important historical cartographic data, much of which is omitted on more recent topographic maps.

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INCREASED DATA ACCESS VIA WEB MAPPING APPLICATIONS

The Division of Geological & Geophysical Surveys (DGGS) is increasingly looking to electronic data delivery to quickly provide up-to-date, detailed information to the public. Specifically DGGS is currently developing several online map- and text-based search interfaces to allow public access to a variety of data types, including applications to discover publications (below), fossil data (below), unpublished geologic data (see page 68), and geophysical surveys (see page 42). This technology can also supply online real-time data services (i.e., Web Feature Services [WFS]) that users may easily open and manipulate in their own Geographic Information System (GIS) software. Of course, most DGGS publications are also available as free downloads from http://www.dggs.alaska.gov/pubs/ and via print-on-demand from the DGGS Fairbanks office.

The "Geologic Map Index of Alaska" web application (fig. 1) will, when complete, provide the locations, outlines, and current status of Alaska geological and geophysical maps from all government agencies in a single, interactive, Internet-accessible location. No geographic index of Alaska geologic maps exists at this time. DGGS is working with Geographic Information Network of Alaska (GINA) at the University of Alaska Fairbanks to upgrade the Map Index interface to a fully integrated map- and text-based search application based on real-time data served from DGGS's central Oracle database. DGGS anticipates that the web application will be completed in late 2013. This upgraded resource will make it easier for the public and government agencies to find the maps they need to make informed resource- and land-management decisions.

Figure 1. Geologic Map Index of Alaska application.

The Alaska Paleontology Database contains detailed information on fossils and fossil localities in Alaska (fig. 2). The database was originally created by Alaska paleontologist Robert Blodgett and paleontologist/computer programmer Ning Zhang, and hosted on a privately owned server. DGGS optimized the database and migrated the structure and data to DGGS's Digital Geologic Database so the database is ensured regular maintenance, back-up, continued data expansion, and consistent public internet access. The online, interactive, spatially enabled application will be released in summer 2013.

Both of these projects were initiated with funding from the federal Minerals Data and Information Rescue in Alaska (MDIRA) program and continue to be supported by State of Alaska general funds. The primary objective of the MDIRA program is to ensure that all available Alaska minerals-related data are preserved in a safe and readily accessible format.

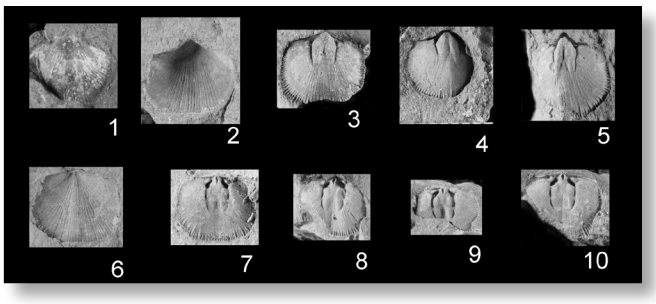

Figure 2. Photographs of fossils described in the Alaska Paleontology Database.

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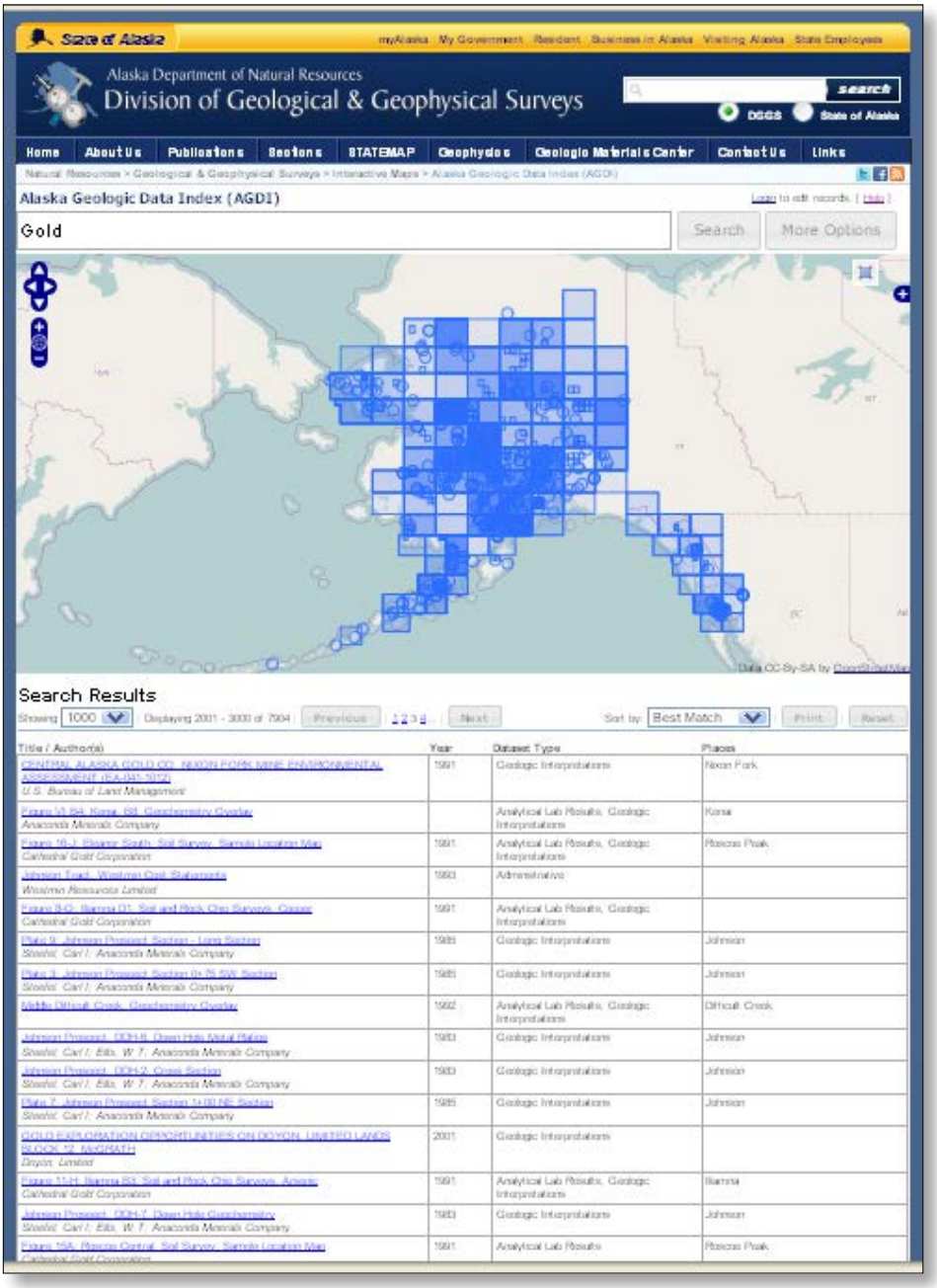
ALASKA GEOLOGIC DATA INDEX (AGDI)

The Alaska Geologic Data Index (AGDI) online application delivers a growing list of unpublished public- and private-sector geologic data for Alaska from any subdiscipline of geology, including oil and gas, engineering geology, mineral resources, scientific data, and agency archives. Information about the data is easily discovered through a map-based search application (http://maps.dggs.alaska.gov/agdi/) that allows web-based public queries of the data. An online data-entry interface conveniently supports the expansion of AGDI database holdings over time; administrative capabilities provide for routine, secure data maintenance. The database currently contains 16,991 records. Potential data contributors are encouraged to contact DGGS at dnr.dggs.webapps@alaska.gov to find out more about the project.

Prior to release, the AGDI database was integrated with the Alaska Mineral Industry Data Index (AKMIDI), a federal Minerals Data and Information Rescue in Alaska (MDIRA) project that catalogued nearly 16,000 records of mineral resource information owned by 18 diverse organizations, including Native corporations, private companies, state libraries, and land managers. The AKMIDI data includes information needed to find industry reports and maps, field notes, drill logs, and other data from the private sector. Much of the data is still held and controlled by private entities. Approximately 1,800 files and 4,300 maps from the Anaconda Collection of minerals exploration data are available through Alaska Resources Library and Information System (ARLIS) and Geologic Materials Center. Upon addition of public-sector geologic data, the database was renamed the Alaska Geologic Data Index.



The AGDI database captures the physical location of archived physical files, contact information and rules for accessing the data, and three levels of proprietary access. At the most secure level, data owners may make their records invisible to the public and other data owners. Digital images of maps, reports, and other data (such as the images of the Anaconda Collection) can be linked to the relational database so that the public can obtain some insight about the content of a potentially useful map, figure, or photograph without having to retrieve the physical materials from the archive. The application also allows for electronic information to be linked via URL.

AGDI was supported by the federally funded MDIRA program, administered by the U.S. Geological Survey, and released to the public in November 2012. The data will also be available as a Web Feature Service (WFS), an online, real-time data service supported by most Geographic Information System (GIS) software. DGGS believes increased access to hard-to-find, unpublished geologic information will advance scientific knowledge of the geologic framework of Alaska and help spur exploration and informed management of its geologic resources.

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THE ALASKA GEOLOGIC MATERIALS CENTER

The Alaska Geologic Materials Center (GMC) in Eagle River holds nonproprietary rock core and cuttings that represent nearly 13 million feet of exploration and production drilling (76,000 linear feet of core) on Federal, State, and private lands in Alaska, including the Alaska outer continental shelf. Additionally, the collection holds more than 252,000 linear feet of diamond-drilled hard-rock mineral core, representing more than 1,800 exploratory boreholes; rock samples from more than 1,650 oil and gas exploratory or production wells; samples for geotechnical boreholes; and numerous surface rock and sediment samples. The GMC also maintains extensive geochemical data and reports derived from third-party sampling and has an archive of more than 187,000 processed slides, including 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 (DGGS), with support from cooperating government agencies that include the U.S. Bureau of Land Management (BLM), U.S. Geological Survey (USGS), U.S. Bureau of Ocean Energy Management (BOEM), and Alaska Oil and Gas Conservation Commission (AOGCC). The mission of the GMC is to permanently archive, index, protect, and make available for public inspection, accessible geologic materials and related data to help advance exploration and knowledge of Alaska's natural resources. 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.

GMC staff has incorporated 99 percent of the entire oil and gas collection and 95 percent of the hard-rock mineral core into a working bar-code/database system. This massive effort will make the future transition to a new, planned repository much more manageable and vastly improve the quality of the collection data. GMC staff, now with a better understanding of its entire inventory and sampling usage, is working with DGGS programmers to rewrite its archival database from scratch. The new structure will support web-based searches for the public and give staff members the ability to retrieve inventory information on-the-fly from a tablet device directly from the warehouse floor.

The GMC hosted 501 visits by industry, government, academic personnel, and the general public to examine rock samples and processed materials in 2012, down 10 from last year's record-breaking 511 visits. Just over half of the visits to the facility are from the oil and gas and minerals industries, however, academic researchers and the general public represented the second and third-largest groups to visit the GMC during the last three years. We would like to continue to improve upon this level of collaboration and make a strong, concerted effort to assist those involved in academic research, and provide high-quality education and outreach to the general public (fig. 1).

Fig. 1. GMC staff member Kurt Johnson "builds a geologist" with kids from the Parks & Rec. summer camp.

GMC staff has performed quality control on its entire 30-year archive of 400+ GMC data reports. Many of these reports are produced to document third-party analyses of samples at the GMC. Although the reports have not undergone technical peer review, the information and data are extremely useful and can help reduce the loss of sample material from the GMC archive, play a large role in multi-agency reanalysis projects, and aid in decision-making during the exploration process. Similarly, a recent interest in the field-sample information found within the GMC's massive collection of 3,500+ maps from the CIRI-Anaconda Corporation has created a beneficial opportunity (see quote) resulting in high-resolution scans of over 200 maps, many of which contain in-line tables of geochemical analyses for the located samples.

> "Scans of the CIRI-Anaconda maps acquired from the GMC will save my client over a hundred thousand dollars worth of helicopter-supported geological mapping this field season, allowing us to focus our efforts and free-up more funds for drilling and potential discovery." – Anonymous geologic consultant

Contact: Kenneth Papp, GMC Curator, 907-696-0079, kenneth.papp@alaska.gov

Contract curator and former Alaska State Geologist Don Hartman has completed a major curation project involving invaluable NPR-A core samples from the USGS collection that were at risk of substantial data loss and potential damage from transporting the samples. As a result, 1,187 three-foot core sections, representing 22 oil and gas wells, including Ikpikpuk Core Test #1, East Simpson Test Well #1, Atigaru Pt. #1, and Lisburne Test Well #1, were examined for quality control, re-boxed, bar-coded, and indexed into the GMC database.

The GMC has improved the usability and size of its core viewing area. An additional core viewing area has been added in the main warehouse with proper viewing tables and improved lighting to better accommodate users who wish to view and photograph samples (fig. 2). A private sample viewing area is also now available in a 20-ft section of a heated, mobile office trailer.

With the help of the Alaska Department of Transportation & Public Facilities (DOTPF), DGGS completed a federally funded concept study in 2006 for a replacement facility for the existing GMC. Constructive discussions regarding the facility's design, engineering, and site-selection continue through a project managed by the Department of Administration (DOA) with support from State Capital Improvement Project (CIP) funds. A private engineering firm contracted by DOA is updating the concept design while GMC staff are proactively preparing the entire sample archive and finalizing an inventory transfer plan for an anticipated future move.

Fig. 2. A small section of shelving was removed to make room for a new, sample viewing area at the GMC.

PUBLICATIONS RELEASED IN 2012

DGGS REPORTS

AR 2011	DGGS Staff, 2012, Alaska Division of Geological & Geophysical Surveys Annual Report, 86 p.
DDS 1	Crafford, T.C., Crafford, Elizabeth, and others, comps., 2012, Alaska Geologic Data Index (AGDI).
GMC 399	Boyer, D., 2012, Thin section photomicrographs and descriptions for the Ikpikpuk #1, Inigok #1, J.W. Dalton #1, and W.T. Foran wells, 17 p.
GMC 400	Posey, C.M. and Evergreen Resources, Inc., 2012, Core photographs and well history files for the Houston Pit #1, Kashwitna Lake #1, Little Su #1, Sheep Creek #1, and Slats #1 coal-bed methane wells, 281 p., 2 disks.
GMC 401	Caribou King Resources, 2012, Core photographs, lithologic logs, drilling data, and borehole inventory for the Caribou Dome Prospect, Valdez Creek Mining District, Alaska, 87 p., 1 disk.
GMC 402	Full Metal Minerals, 2012, Borehole inventory, assay results, drilling data, lithologic descriptions, and Microsoft Access file for the Grizzly Butte Prospect, Valdez Creek Mining District, Alaska, 9 p.
GMC 403	Full Metal Minerals and Calista Corporation, 2012, Borehole inventory, assay results, drilling data, lithologic descriptions, and Microsoft Access file for the Russian Mountains prospect (Owhat, Louise, and Headwall) Aniak mining district, Alaska, 15 p.
GMC 404	Shennan, I., Barlow, N., Pierre, K., Stuart-Taylor, O., and Sea Level Research Unit, Department of Geography, Durham University, 2012, Diatom stratigraphy of Borehole TA8, Portage, Alaska, 26 p.
GMC 405	Petrotechnical Resources of Alaska and TestAmerica Laboratories, Inc., 2012, Geochemical analyses of oil and gas cuttings from the Brontosaurus #1, Walakpa #1, S. Barrow #14, and S. Barrow #19 wells, 41 p.
GMC 406	Caruthers, A., 2012, Carbon isotope and total organic carbon (TOC) analysis of washed and unwashed cuttings from the South Barrow Test #3 well, 1 p., 2 spreadsheets available for download.
GMC 407	URS Corp. (Alaska), 2012, Drilling procedures, sample descriptions, boring logs, borehole locations, and archive inventory for 32 near-shore marine sediment Vibracore samples, West Dock Causeway, Prudhoe Bay, Alaska, 23 p.
GMC 408	Andover Mining Corp. and ALS Minerals, 2012, Current and historical assay results, core photos, drill collar locations, and sampling report for the Picnic Creek/Hot (boreholes 1, 2, and 7) and Sun (boreholes 2, 3, 4, 9, 11, 12, 14, and 22) mineral prospects, Ambler Mining District, Survey Pass Quadrangle, Alaska, 33 p., 1 disk.
GMC 409	Ucore Rare Metals Inc. and ALS Minerals, 2012, Trace rare earth element (TREE), heavy rare earth element (HREE), and whole rock element data from core splits, Ross Adams deposit, Bokan Mountain, Dixon Entrance Quadrangle, Alaska, 1 p.
GMC 410	Ucore Rare Metals Inc. and ALS Minerals, 2012, Trace rare earth element (TREE) and heavy rare earth element (HREE) data from hand samples and pan concentrates, Ray Mountains region, Tanana Quadrangle, Alaska, 1 p.
GMC 411	Newberry, R.J., 2012, Whole-rock and trace element analyses of two amphibolite outcrop samples from the 2001 DGGS Salcha River-Pogo project, Big Delta quadrangle, Alaska, 1 p.
GMC 412	Gottlieb, E., 2012, LaserChron (Nu Instruments High Resolution ICP Mass Spectrometer) data of core from the East Simpson Test Well #1, Ikpikpuk Test Well #1, Inigok Test Well #1, and Peard Test Well #1 wells, 1 p.
GMC 413	Gottlieb, E., 2012, LaserChron (Nu Instruments High Resolution ICP Mass Spectrometer) data of Triassic and Carboniferous outcrop samples from the Karen Creek, Ivishak, and Nuka Formations, western and eastern Brooks Range, Alaska, 1 p.
GMC 414	Gottlieb, E., 2012, Sensitive High Resolution Ion Micro Probe (SHRIMP) data of outcrop samples from the western Brooks Range and central North Slope foothills, Alaska, 1 p. Lab results (delimited text files).
GMC 415	Raven, R. and Chemostrat, Inc., 2012, ICP optical emission and mass spectrometry data of cuttings from the Kalubik #3, Colville Delta #2, and E. Harrison Bay #1 wells, 1 p.
MP 141	Koehler, R.D., Farrell, Rebecca-Ellen, Burns, P.A.C., and Combellick, R.A., 2012, Quaternary faults and folds in Alaska: A digital database, 31 p., 1 sheet, scale 1:3,700,000. The map sheet is still under review and not yet available for download.
MP 142	Szumigala, D.J. and Weakland, J.R., 2012, Alaska's mineral resources, 1 sheet, scale 1:4,000,000.
MP 143	Schaefer, J.R. and Wallace, K.L., 2012, Ash fall contour map of the 2009 eruption of Redoubt Volcano, Alaska: Digital shapefiles of contours and sample locations, 1 disk.
MP 144	Hickman, P.J., Suleimani, E.N., and Nicolsky, D.J., 2012, Digital elevation model of Sitka Harbor and the city of Sitka, Alaska: Procedures, data sources, and quality assessment, 38 p.
MP 145	Pond, Franklin, comp., 2012, Willard B. Jewell (1899-1969): southeast Alaska photographs, 1924-1925, 98 p.
MP 146	DGGS Staff, 2012, Geologic basins and energy resources of Alaska, 1 sheet, scale 1:3,700,000.

MP 147 Smith, J.R., Gray, Glenn, and Kinsman, N.E.M., 2012, Annotated bibliography series in support of coastal community hazard planning-Northwest Alaska, 5 p. A digital database file has been produced for release as part of this publication. This database file includes the complete bibliographic information and general annotations for the source materials included on all of the individual.

MP 147A	Barrow	MP 147L	Point Lay
MP 147B	Clark's Point & Ekuk	MP 147M	Quihagak
MP 147C	Deering	MP 147N	Saint Michael
MP 147D	Gambell	MP 147O	Savoonga
MP 147E	Golovin	MP 147P	Scammon Bay
MP 147F	Hooper Bay	MP 147Q	Selawik
MP 147G	Kaktovik	MP 147R	Shaktoolik
MP 147H	Kivalina	MP 147S	Shishmaref
MP 147I	Kotlik	MP 147T	Teller
MP 147J	Kwigillingok	MP 147U	Unalakleet
MP 147K	Nunamiqua (Sheldon Point)		

MP 148 Koehler, R.D., Carver, G.A., Scher, R.L., Kelly, L.W., White, G.L., Miller, D.E., and Aho, J.L., 2012, Pacific northwest earthquakes and potential effects on Alaska, 8 p.

PIR 2002-1D Stevens, D.S.P., 2012, Engineering-geologic map of the Eagle A-1 Quadrangle, Fortymile mining district, Alaska, 1 sheet, scale 1:63,360.

PIR 2012-1A Reger, R.D., Hubbard, T.D., and Gallagher, P.E., 2012, Surficial geology of the Alaska Highway corridor, Tetlin Junction to Canada border, Alaska, 25 p., 2 sheets, scale 1:63,360.

PIR 2012-1B Hubbard, T.D., Reger, R.D., and Gallagher, P.E., 2012, Engineering-geologic map of the Alaska Highway corridor, Tetlin Junction to Canada border, Alaska, 2 sheets, scale 1:63,360.

PIR 2012-1C Reger, R.D., Hubbard, T.D., and Gallagher, P.E., 2012, Reconnaissance interpretation of 1978-1981 permafrost, Alaska Highway corridor, Tetlin Junction to Canada border, Alaska, 27 p., 2 sheets, scale 1:63,360.

PIR 2012-2 Koehler, R.D. and Carver, G.A., 2012, Active and potentially active faults along the Alaska Highway corridor, Tetlin Junction to the Canada border, 23 p.

RDF 2011-3O Hubbard, T.D., Braun, M.L., Westbrook, R.E., and Gallagher, P.E., 2012, High-resolution lidar data for infrastructure corridors, Gulkana Quadrangle, Alaska.

RDF 2011-3P Hubbard, T.D., Braun, M.L., Westbrook, R.E., and Gallagher, P.E., 2012, High-resolution lidar data for infrastructure corridors, Valdez Quadrangle, Alaska.

RDF 2011-3Q Hubbard, T.D., Braun, M.L., Westbrook, R.E., and Gallagher, P.E., 2012, High-resolution lidar data for infrastructure corridors, Beechey Point Quadrangle, Alaska.

RDF 2011-3R Hubbard, T.D., Braun, M.L., Westbrook, R.E., and Gallagher, P.E., 2012, High-resolution lidar data for infrastructure corridors, Chandalar Quadrangle, Alaska.

RDF 2011-3S Hubbard, T.D., Braun, M.L., Westbrook, R.E., and Gallagher, P.E., 2012, High-resolution lidar data for infrastructure corridors, Philip Smith Mountains Quadrangle, Alaska.

RDF 2011-3T Hubbard, T.D., Braun, M.L., Westbrook, R.E., and Gallagher, P.E., 2012, High-resolution lidar data for infrastructure corridors, Sagavanirktok Quadrangle, Alaska.

RDF 2011-4 v. 2 Lough, T.A., Freeman, L.K., Elliott, B.A., Griesel, G.A., Newberry, R.J., and Szumigala, D.J., 2012, Geochemical, major-oxide, minor-oxide, trace-element, and carbon data from rocks collected in 2011 in the Moran area, Tanana and Melozitna quadrangles, Alaska, 176 p.

RDF 2011-5 DeRaps, M.R. and Kinsman, N.E.M., 2012, Spatially referenced oblique aerial photography of the Eastern Norton Sound shoreline, July 2011, 3 disks.

RDF 2011-6 Schaefer, J.R., Larsen, J.F., and Unema, J.A., 2012, Digital elevation model (DEM) and shaded relief image of Okmok Caldera, 2010, 1 disk. Digital elevation model (DEM) and shaded relief image are derived from 21 January 2010 Worldview-1 satellite imagery.

RDF 2012-1 Zippi, P.A. and Loveland, A.M., 2012, Palynological analysis of 228 outcrop samples from the Kenai, Seldovia, and Tyonek quadrangles, Cook Inlet region, Alaska, 10 p.

RDF 2012-2 Werdon, M.B., Gallagher, P.E., and Blessington, M.J., 2012, Geochemical, major-oxide, minor-oxide, trace-element, and rare-earth-element data from rock, stream sediment, and pan-concentrate samples collected in 2011 in the William Henry Bay area, Juneau C-4 and D-4 quadrangles, Southeast Alaska.

RDF 2012-3 Freeman, L.K., Szumigala, D.J., Blessington, M.J., and Werdon, M.B., 2012, Geochemical trace-element and rare-earth element data from stream-sediment and pan-concentrate samples collected in 2011 in the Melozitna mining district, Tanana and Melozitna quadrangles, interior Alaska, 3 p.

RDF 2012-4 DeRaps, M.R. and Kinsman, N.E.M., 2012, Spatially referenced oblique aerial photography of the Golovin shoreline, July 2012, 2 p.

RI 2012-1 LePain, D.L., Lillis, P.G., Helmold, K.P., and Stanley, R.G., 2012, Migrated hydrocarbons in exposure of Maastrichtian nonmarine strata near Saddle Mountain, lower Cook Inlet, Alaska, 13 p.

RI 2012-2 Kinsman, N.E.M. and DeRaps, M.R., 2012, Coastal hazard field investigations in response to the November 2011 Bering Sea storm, Norton Sound, Alaska, 51 p., 1 sheet.

SR 66 Swenson, R.F., Wartes, M.A., LePain, D.L., and Clough, J.G., 2012, Fossil fuel and geothermal energy sources for local use in Alaska: Summary of available information, 144 p., 2 sheets, scale 1:3,700,000.

SR 66A Clough, J.G., Decker, P.L., Helmold, K.P., and Nye, C.J., 2012, Geologic requirements for exploitable fossil fuel and geothermal energy resources.

SR 66B Decker, P.L., Gillis, R.J., Helmold, K.P., and Peterson, Shaun, 2012, Summary of fossil fuel and geothermal resource potential in Aleutians energy region.

SR 66C Montayne, Simone, Wartes, M.A., and Clough, J.G., 2012, Summary of fossil fuel and geothermal resource potential in the Bering Straits energy region.

SR 66D Decker, P.L., Gillis, R.J., Helmold, K.P., and Peterson, Shaun, 2012, Summary of fossil fuel and geothermal resource potential in the Bristol Bay energy region.

SR 66E Decker, P.L., Gillis, R.J., Helmold, K.P., and Peterson, Shaun, 2012, Summary of fossil fuel and geothermal resource potential in the Copper River-Chugach energy region.

SR 66F Decker, P.L., Gillis, R.J., Helmold, K.P., and Peterson, Shaun, 2012, Summary of fossil fuel and geothermal resource potential in the Kodiak energy region.

SR 66G LePain, D.L., 2012, Summary of fossil fuel and geothermal resource potential in the Lower Yukon-Kuskokwim energy region.

SR 66H Wartes, M.A., 2012, Summary of fossil fuel and geothermal resource potential in the North Slope energy region.

SR 66I Wartes, M.A., 2012, Summary of fossil fuel and geothermal resource potential in the Northwest Arctic energy region.

SR 66J Decker, P.L., Gillis, R.J., Helmold, K.P., and Peterson, Shaun, 2012, Summary of fossil fuel and geothermal resource potential in the Railbelt energy region.

SR 66K Decker, P.L., Gillis, R.J., Helmold, K.P., and Peterson, Shaun, 2012, Summary of fossil fuel and geothermal resource potential in the Southeast energy region.

SR 66L LePain, D.L. and Wartes, M.A., 2012, Summary of fossil fuel and geothermal resource potential in the Yukon-Koyukuk/Upper Tanana energy region.

SR 67 Szumigala, D.J., 2012, Alaska's mineral industry 2011 - exploration activity, 10 p.

OUTSIDE PUBLICATIONS

Athey, J.E., 2012, A plan and plea for increasing communication about digital geologic field mapping, *in* Soller, D.R., ed., Digital Mapping Techniques '10—Workshop Proceedings, Sacramento, California, May 16–19, 2010: U.S. Geological Survey Open-File Report 2012–1171, 170 p., http://pubs.usgs.gov/of/2012/1171/.

Benowitz, J.A., Haeussler, P.J., Layer, P.W., O'Sullivan, P.B., Wallace, W.K., and **Gillis, R.J.,** 2012, Cenozoic tectonothermal history of the Tordrillo Mountains, Alaska: Paleocene-Eocene ridge subduction, decreasing relief, and late Neogene faulting: Geochemistry, Geophysics, Geosystems, v. 13, 22 p., doi:10.1029/2011GC003951.

Kinsman, N., and Xu, J.P., 2012, The fluorescent tracer experiment on Holiday Beach near Mugu Canyon, Southern California: U.S. Geological Survey Open-File Report 2012-1131, 23 p., http://pubs.er.usgs.gov/publication/ofr20121131.

Koehler, R.D., Mann, P., Prentice, C.S., Grandison-Wiggins, M., Bedford, B., and Brown, L., 2012, The Enriquillo-Plantain Garden fault in Jamaica: Paleoseismology and seismic hazard: Bulletin of the Seismological Society of America, v. 103, issue 2a.

Mastin, L.G., Schwaiger, Hans, Schneider, D.J., Wallace, K.W., **Schaefer, J.R.,** Denlinger, R.P., 2012, Injection, transport, and deposition of tephra during event 5 at Redoubt Volcano, 23 March, 2009: Journal of Volcanology and Geothermal Research, in press, available online 5 May 2012, http://www.sciencedirect.com/science/article/pii/S0377027312001254.

Sharp, M., **Wolken, G.,** Geai, M.L., and Burgess, D., 2012, Mountain glaciers and ice caps (outside Greenland), *in* Jeffries, M.O., Richter-Menge, J.A., and Overland, J.E., eds., Arctic Report Card 2012: NOAA, p. 140–145, http://www.arctic.noaa.gov/reportcard.

Sharp, M., and **Wolken, G.,** 2012, Glaciers and ice caps (outside Greenland), *in* Blunden, J., and Arndt, D.S., eds., 2012, State of the Climate in 2011: Bulletin of the American Meteorological Society, v. 93, issue 7, p. S133–S134.

Sonntag, R., Evans, J.P., La Pointe, P., **DeRaps, M.,** Sisley, H., and Richey, D., 2012, Sedimentological controls on the fracture distribution and network development in Mesaverde Group sandstone lithofacies, Uinta Basin, Utah, USA, *in* Spence, G.H., Redfern, J., Aguilera, R., Bevan, T.G., Cosgrove, J.W., Couples, G.D., and Daniel, J.M., eds., 2012, Advances in the Study of Fractured Reservoirs: Geological Society, London, Special Publications, v. 374, doi:10.1144/SP374.4.

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RDF 2011-3F	Hillshade images, Bettles Quadrangle	11
RDF 2011-3F	Intensity images, Bettles Quadrangle	6
RDF 2011-3F	Lake polygons, Bettles Quadrangle	6
RDF 2011-3F	Mean Vegetation Elevation, Bettles Quadrangle	3
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RDF 2011-3I	Lake polygons, Talkeetna Quadrangle	8
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RDF 2011-3K	Intensity images, Livengood C-5 Quadrangle	6
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RDF 2011-3L	Intensity images, Anchorage Quadrangle	8
RDF 2011-3L	Lake polygons, Anchorage Quadrangle	8
RDF 2011-3L	Mean Vegetation Elevation, Anchorage Quadrangle	1
RDF 2011-3L	Normalized digital surface model (nDSM), Anchorage Quadrangle	6
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RDF 2011-3M	Lake polygons, Healy Quadrangle	9
RDF 2011-3M	Mean Vegetation Elevation, Healy Quadrangle	2
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RDF 2011-3N	Lake polygons, Talkeetna Mountains Quadrangle	5
RDF 2011-3N	Mean Vegetation Elevation, Talkeetna Mountains Quadrangle	1
RDF 2011-3N	Normalized digital surface model (nDSM), Talkeetna Mountains Quadrangle	3
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RDF 2011-3O	Bare-earth digital elevation model (DEM), Gulkana Quadrangle	8
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RDF 2011-3O	Coefficient variation, Gulkana Quadrangle	3
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RDF 2011-3O	Intensity images, Gulkana Quadrangle	4
RDF 2011-3O	Lake polygons, Gulkana Quadrangle	4
RDF 2011-3O	Mean Vegetation Elevation, Gulkana Quadrangle	1
RDF 2011-3O	Normalized digital surface model (nDSM), Gulkana Quadrangle	5
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RDF 2011-3P	Bare-earth digital elevation model (DEM), Valdez Quadrangle	11
RDF 2011-3P	Canopy cover, Valdez Quadrangle	5
RDF 2011-3P	Coefficient variation, Valdez Quadrangle	1
RDF 2011-3P	Highest hit digital surface model (DSM), Valdez Quadrangle	3
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RDF 2011-3P	Lake polygons, Valdez Quadrangle	5
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PUBLICATION NUMBER	PUBLICATION SHORT TITLE	2012 DOWNLOADS
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