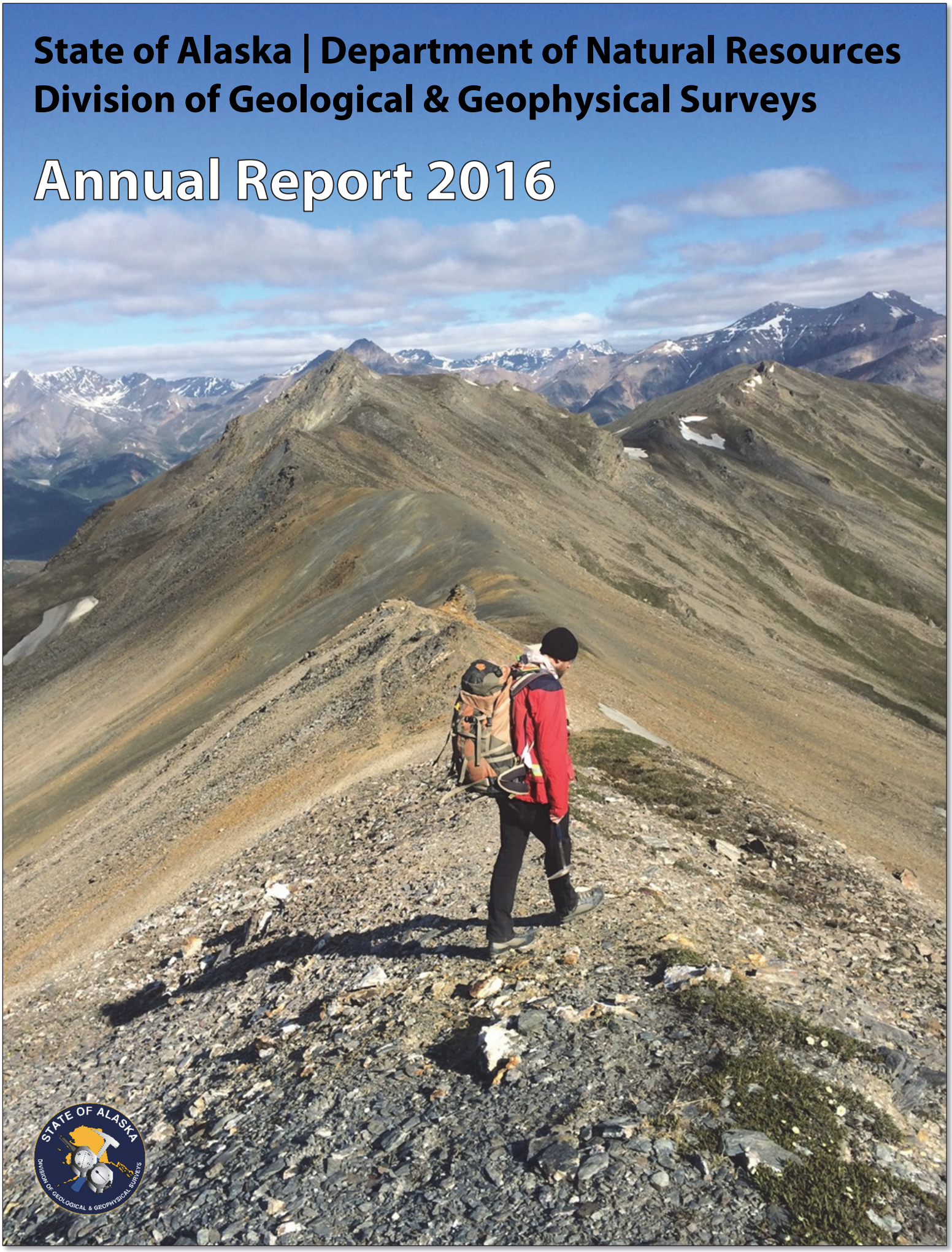
State of Alaska | Department of Natural Resources
Division of Geological & Geophysical Surveys

Annual Report 2016



STATE OF ALASKA

Bill Walker, *Governor*

DEPARTMENT OF NATURAL RESOURCES

Andrew T. Mack, *Commissioner*

DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

Steve Masterman, *State Geologist and Director*

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Alaska Division of Geological & Geophysical Surveys
3354 College Road, Fairbanks, Alaska 99709-3707
Phone: 907.451.5010 | Fax: 907.451.5050
dggspubs@alaska.gov | http://www.dggs.alaska.gov

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MISSION STATEMENT, DEPARTMENT OF NATURAL RESOURCES

Develop, conserve, and enhance natural resources for present and future Alaskans

MISSION STATEMENT, DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

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)

Front Cover: DGGS geologist Evan Twelker on traverse in the eastern Alaska Range during the 2016 Tok River geologic mapping project. Photo by Lauren Lande.

Back Cover: Sitka residential area, viewed from the headscarp of a recent landslide. On August 18, 2015, heavy rainfall and wind initiated more than 45 landslides on Chichagof and Baranof Islands. Four debris flows impacted roads and infrastructure in Sitka, and one of the flows took the lives of three residents. DGGS responded immediately to the Sitka debris flow events by providing rapid-response geologic hazards support. In an effort to help guide future planning and emergency response preparation in Sitka, we successfully secured funding from the Federal Emergency Management Association (FEMA) in late 2016 to assess and map landslide hazards for the developed areas around the community.

FROM THE DIRECTOR…

Greetings! This annual report is a brief summary of the many achievements of the energetic, resourceful, and committed staff at Alaska's geological survey. I hope you take time to read it, and learn more about the great work done by DGGS.

Investing in publicly available geologic information is necessary for the discovery and commercialization of the state's geologic (oil, gas, coal, and minerals) resources and in protecting Alaskans from geologic hazards. It is an investment in future mines, oil and gas production, State revenue, jobs, and a sound economy.

Continuing our long commitment toward understanding Alaska's petroleum systems, DGGS published a report on the Nanushuk Formation from the western North Slope, showing evidence that the host rocks to the Pikka unit discovery continue as excellent reservoir rocks more than 200 miles from the Pikka unit. During the past year another significant oil discovery was announced from the North Slope, in a sequence of rocks about which we have published numerous reports and maps in the past decade. On reaching production, this discovery will return billions in revenue to the State.

DGGS provided data on the geology and mineral resource potential of the Bonnifield and Tok areas. Mining companies responded to these data releases by staking large blocks of mining claims, which not only directly contributes to state revenue and Alaska's economy, but also demonstrates that DGGS is using its State funding to produce the right information in the right locations, and is positively contributing to the State's economy.

DGGS became a Cooperating Technical Partner with FEMA, being awarded grants in Sitka and Emmonak to aid with landslide and erosion hazard mitigation in those communities. DGGS plans to continue to help Alaskans understand and mitigate geologic hazards to their communities, and will be working closely on the community and regional levels to ensure geologic hazards are adequately accounted for in community and regional planning. We at DGGS are thankful for the opportunity to help our fellow Alaskans, and we stand ready to assist communities should they experience natural disasters.

DGGS coastal inundation maps were validated during, thankfully, moderate flood events this fall in western Alaska. Ongoing collaboration with the National Weather Service to incorporate DGGS inundation products into their storm-surge forecasts will help inform coastal residents ahead of future storms. Providing practical and usable products to aid community and public safety in times of emergency is a core priority for us, and it is reassuring to know we are providing the kinds of materials communities find useful.

DGGS's Elevation Datasets in Alaska web page continues to grow in popularity, and in the amount of data housed and distributed. This has become the *de facto* portal for digital elevation data in the state. DGGS staff created this unique interface that provides access for viewing and downloading digital topographic data. Recognizing the power and utility of the site, numerous organizations are now contributing data voluntarily, and it has rapidly become the go-to place for Alaska digital topographic data. For a small organization, this speaks volumes about the quality, capability, and vision of our technical staff.

2016 saw a dramatic increase in the amount of data obtained from our website. Almost 900,000 publications were downloaded throughout the year, and we recorded more than 36.9 million web page views. These are both huge increases over prior years, and illustrate that DGGS products are highly valued by our customers, and that maintaining Alaska's repository of geologic data is essential.

Several years ago, the Alaska Legislature recognized the value of the State's archive of geologic materials and appropriated funding for a new facility. This past legislative session, legislators once again took the initiative and passed SB170, a bill allowing DGGS to collect revenue from services and products offered at the facility. This will be a major change for both DGGS and our customers, but will help fund the operation of the Geologic Materials Center and ensure this invaluable collection remains accessible.

These snapshots are just a few of the notable achievements of the Division during the last year. I encourage you to read this report and learn more about Alaska's geological survey, its projects, activities, products, and impacts.

Respectfully,

S. Masterman

Steven S. Masterman
State Geologist & Director

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Alaska Division of Geological & Geophysical Surveys

ANNUAL REPORT 2016

KEY ISSUES

DGGS faces numerous critical issues, and must determine the strategic allocation of available resources to balance the needs of the broader state economy with the needs of local communities, all while ensuring that we fulfill our mission.

One of the largest issues DGGS faces is being undersized relative to the size of Alaska, which means we have limited capacity to fulfill our mission in a reasonable amount of time. As an example, the rate of geologic mapping over the past 20 years indicates it will take DGGS at least another 400 years to complete a geologic map of the state at 1-inch-to-1-mile scale. Geologic maps are a foundational dataset for all energy and mineral development and also engineering geology, geologic hazards, groundwater, and construction materials investigations. Similar time scales apply to other basic types of geologic data needed to fulfill the division's mission. This process needs shortening for the state to achieve the potential inherent in its energy and mineral resources in a reasonable timeframe.

OIL AND GAS DEVELOPMENT

Recent discoveries on Alaska's North Slope indicate there are many more barrels of oil to be found. The North Slope and Cook Inlet are both mature hydrocarbon basins. Like all mature hydrocarbon basins, the "easy" prospects are drilled and tested early, with the untested, remaining plays requiring significant geologic research and investment to reach discovery and production. Industry use of DGGS reports and samples illustrates the value in making and keeping high-quality geologic data available. New geologic information is the key to ensuring new resource discoveries. DGGS will continue to be challenged to provide sufficient new information on petroleum systems that will lead to discoveries in these more challenging plays.

As Alaska's vast potential for unconventional energy resources comes into focus DGGS will be challenged to provide the necessary information in sufficient volume to stimulate the development of these new and varied resource types.

The bulk of energy exploration and development is focused in two areas: the North Slope and Cook Inlet. Many other areas in Alaska have hydrocarbon potential, but are currently not being explored. DGGS will be challenged to continue to provide sufficient geologic information to attract exploration into inactive hydrocarbon basins.

MINERAL DEVELOPMENT

The need for statewide digital geologic datasets to keep Alaska well positioned relative to competing markets is increasingly important because of fierce global competition for exploration expenditures. Alaska ranks very high in terms of mineral potential, but its current mid-tier rank in terms of the quality of its geologic datasets is falling. Improving these datasets will entice exploration to the state. DGGS welcomes this challenge and will be doing everything possible to meet the needs of the industry. High-priority mineral belts will be the focus of DGGS efforts.

Rapidly changing technology results in rapid changes in commodity needs. This situation creates a fluid

and evolving commodities market with rapid price adjustments to changing metal needs. DGGS will be challenged to provide sufficient new data and interpretations related to the occurrence of emerging commodities in a timely manner for industry to respond to these new demands. DGGS will also be challenged to be forward-looking to anticipate demands for geoscience data and to respond to surges in demand for commodity-specific geoscience data. DGGS will be challenged to move at the required speeds during commodity price fluctuations.

PUBLIC SAFETY AND COMMUNITY RESILIENCE

Despite Alaska's abundance of geologic hazards, such as earthquakes, tsunamis, volcanoes, landslides, avalanches, and others, there is a grave lack of systematic, statewide data to allow assessment of natural hazards risks. Communities, residents, project proponents, and managers alike suffer from this lack of basic data. Providing basic statewide geologic hazards data will remain a challenge and priority for DGGS.

Geologic information is needed in a number of key community resiliency efforts. Most importantly, these data are essential in coastal and river communities, which are impacted by erosion, storm surges, landslides, sea-level change, changes in the hydrologic system, and thaw settlement from degradation of permafrost. DGGS will be challenged to continue its efforts to provide basic information to guide community and regional resiliency efforts.

The State has historically relied on site-specific hazards analyses related to ongoing development or permit approval. There is a growing need for up-to-date regional and statewide baseline data. DGGS will be challenged to provide these data before they are required to manage crisis situations.

Construction materials are in critically short supply in numerous areas of the state. The lack of affordable basic construction materials can dramatically affect project economics, making some projects uneconomic or unaffordable. Meeting this need for information will continue to be a challenge for DGGS.

LOCAL ENERGY SUPPLY

A return to high energy prices will have a significant impact on the economies of rural Alaska and threaten the viability of rural communities. Many remote areas of the state lack sufficient geologic information about potential alternate forms of local energy such as shallow natural gas, coal, geothermal, and conventional gas resources. 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. Providing targeted geologic data where it will help local governments understand the locally available resources, and the development challenges associated with them, will remain a key challenge. 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 who need it, moving Alaska toward a more secure and affordable energy future.

THE CHANGING ARCTIC CLIMATE

Continued Arctic warming since the last glacial maximum will undoubtedly increase maintenance requirements on Alaska's buildings and rail, highway, and airport systems. Identifying geologic hazards and areas prone to ground failure will be necessary to mitigate these changes. Impacts from climate change will be most extreme in coastal, low-lying areas, and areas that will be destabilized by thawing permafrost.

As climate change effects are more widely observed, their Arctic impacts become more broadly appreciated. DGGS geoscientists are playing a leading role in guiding areas of research into the effects of climate change in the Arctic. The expansion of Arctic shipping lanes from Asia to Europe highlights the paucity of basic coastal and maritime data along Alaska's western and northern coasts. As the nation's only Arctic state geological survey, DGGS will be challenged to guide research to provide the necessary data for coastal and nearshore areas, address the effects of Arctic climate change, and identify areas of critical need for the state.

Alaska will be an international focal point for indications and impacts of climate change, which will challenge DGGS's ability to not only guide, but also provide reliable, unbiased data for, the development and evaluation of emerging policy and statute changes. A key objective will be prioritization: because of Alaska's size and the lack of existing data there is more need for data than there are personnel and funding to acquire it. DGGS will be challenged to continue to develop and apply innovative methods and technologies for data acquisition and analysis.

ACCESS TO ALASKA'S GEOLOGIC MATERIALS AND INFORMATION

Our ability to provide geologic data to exploration and development industries will be tested as users demand quicker and more comprehensive information. The Geologic Materials Center (GMC) is a key component of these efforts and is the "first stop" for oil and gas and mineral exploration companies.

Digital mapping techniques, changes in database design, vast volumes of data, and ever-changing computer software and hardware are a challenge to DGGS's ability to meet an increasingly diverse customer base. No longer are paper maps and reports sufficient; digital maps, databases, social media presence, and interactive online maps are among our growing list of distribution methods that are all crucial in an increasingly electronic world. DGGS must continue developing and optimizing its data acquisition, storage, and distribution programs to discover new and more efficient ways to disseminate the information to the groups that use it.

The State's archive of geologic materials represents billions of dollars of acquisition and preservation costs. Providing efficient and comprehensive access to this collection is critically important for viable exploration programs for both seasoned and new Alaska exploration companies. Any one piece of core from this archive has the potential to identify a resource prospect that could bring billions of dollars of revenue to the state. DGGS will be challenged to secure funding to ensure the facility continues to operate, grow, and serve long into the future. To meet this challenge, DGGS will be instituting fees for services at the new facility. This will be an adjustment for our users, but is necessitated by the higher operating and maintenance costs.

PERSONNEL RETENTION AND RECRUITMENT

Cyclical commodity prices create spikes in the exploration cycle, which creates challenges for DGGS. However, low commodity prices will not persist indefinitely. During boom times, high-paying, private-sector jobs become abundant, and opportunities for experienced geoscientists become commonplace. The State must remain competitive in workforce recruitment and keep our best and brightest employees.

FY2017 FOCUS

The role of DGGS is strategic in state revenue generation and the maintenance of Alaska's economy. DGGS provides objective geologic information to assist mineral prospectors, in-state, national, and international mining and energy companies to discover and develop Alaska's mineral and energy resources. DGGS also provides information about construction materials and groundwater, which are critical to developing these economic resources, and evaluates geologic hazards that may adversely impact the state's economy and public safety. DGGS will continue to be the central repository of information on Alaska's resources and will play a pivotal role in their commercialization. DGGS will continue to conduct geologic hazard research to provide a scientific basis to community hazard mitigation efforts.

Specific goals are outlined below:

ENERGY RESOURCES

- Continue providing highly relevant geologic maps and reports for the Cook Inlet and North Slope basins to stimulate resource discovery in the state's primary oil and gas basins.
- Provide new information that highlights the exploration potential of frontier, underexplored, or inactive basins.
- Provide new geologic information on Alaska's vast and diverse unconventional energy resources.
- Release new geology maps from recent field mapping programs, including the Iniskin Peninsula/ Chinitna Bay area in Cook Inlet, and Umiat on the North Slope.
- Provide new information on the liquid petroleum potential of Alaska's coal.
- Conduct core workshop at Pacific Section American Association of Petroleum Geologists (AAPG) focusing on the Nanushuk Formation.
- Lead the Pacific Section of the AAPG field trips.
- Safely conduct a STATEMAP mapping project in Cook Inlet.

MINERAL RESOURCES

- Continue modernization and re-release of airborne geophysics data, and support Division geophysical acquisitions and release.

- Continue release of new geologic maps from recent mapping in high-mineral-potential areas of the state. Publication of the Styx River and Tok map areas are priorities.
- Publication of summary reports on rare-earth and platinum-group occurrences.
- Begin making digital field-station mapping data available via the website.
- Safely complete a geophysical survey in the Porcupine River area, and a reconnaissance geologic mapping project in the Yukon–Tanana gold belt.

PUBLIC SAFETY AND COMMUNITY RESILIENCE

- Begin providing online, interactive statewide hazards maps, starting with avalanche susceptibility and naturally-occurring asbestos.
- Provide additional coastal inundation and erosion data, map products, and online tools to coastal communities.
- Train residents in coastal communities to monitor shoreline change.
- Continue to update shoreline position mapping of Alaska's north and west coast to allow erosion rate forecasting.
- Broaden relationships with university and federal organizations to enhance coastal and hazards capabilities.
- Make additional weather and coastal water-level data available in real time.
- Develop and expand working relationships with hazard mitigation and response organizations through successfully completing a landslide mapping project in Sitka and an erosion project in Emmonak.
- Continue to serve as administrators of the Alaska Seismic Hazard Safety Commission.

DATA DELIVERY AND AVAILABILITY

- Continue the transition to digital and interactive data delivery with new and upgraded interactive maps.
- Complete an update of the online geochemical database and release to the public.
- Launch an updated version of the Digital Elevation Datasets for Alaska application.
- Launch a redesigned website that provides users with easier access to the Division's products and services.

GEOLOGIC MATERIALS CENTER

- Begin charging fees for data and services provided by the facility.
- Complete the process of vacating the old facility.
- Continue outreach and education programs at the new facility to university, grade-school, middle school, and high school students.
- Improve curation of geologic materials by linking location and sample information for the 50,000+ samples without location information.

VOLCANOLOGY

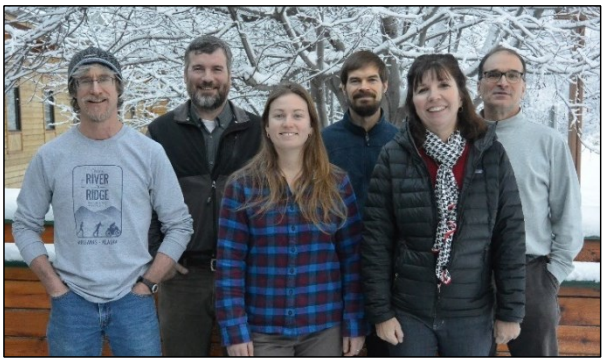
- Publish the geologic map of Kasatochi Volcano.
- Publish the geologic map of Chiginagak Volcano.
- Provide new information on volcanic hazards impacts from Makushin volcano to Unalaska and Dutch Harbor.
- Create a framework of Alaska Peninsula ash fall hazards by analyzing lake core tephras in the region.
- Expand the Geologic Database on Volcanoes in Alaska (GeoDIVA) to hold tephra componentry and tephra petrographic descriptions.

ENERGY RESOURCES SECTION

Creates new geologic information about the state's oil, natural gas, coal, and geothermal resources

BENEFIT TO ALASKA

The Energy Resources Section generates new, unbiased information on the geologic framework of frontier areas in Alaska that may host undiscovered oil, gas, coal, and geothermal resources for improving the success of state-revenue-generating commercial oil and gas exploration and development, and improved understanding of potential local sources of energy for rural Alaska.



Bob Gillis, Marwan Wartes, Mandy Willingham, Trystan Herriott, Nina Harun, and Dave LePain

MAJOR PROGRAMS AND PROJECTS

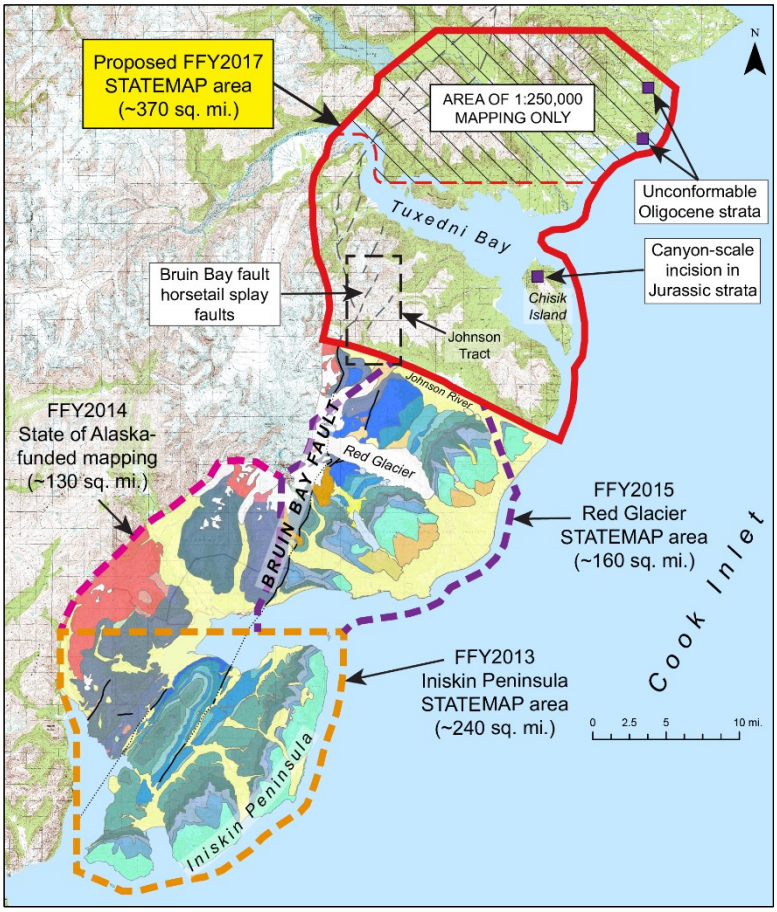
- Cook Inlet basin analysis program
- Brooks Range foothills and North Slope program
- Natural gas potential of the Nenana basin
- Natural gas potential of the Susitna basin
- Liquid hydrocarbon potential of Alaska's coals
- Alaska Coal Database—part of the National Coal Resources Database System

MAJOR ACCOMPLISHMENTS IN 2016

Tuxedni Bay: Filling in the geologic gaps in lower Cook Inlet

In an ongoing effort to attract industry investment in Alaska's petroleum basins, and to help meet local energy demands, the DGGS Energy Section is planning new inch-to-mile-scale bedrock geologic mapping in lower Cook Inlet's Tuxedni Bay area for summer 2017 as part of the multi-year Cook Inlet basin analysis program. The area is important for understanding the older, deeper, Mesozoic interval of the Cook Inlet petroleum system, which has seen little exploration, yet may contain a mean estimate of 227 million barrels (MMB) of undiscovered oil and 1,548 billion cubic feet (BCF) of gas according to a recent 2011 U.S. Geological Survey (USGS) resource assessment.

The 370-square-mile proposed geologic mapping area would build on geologic mapping projects since 2013 on the western margin of the basin, where the complete Mesozoic stratigraphy is exposed at the surface, including the only location where the oil source rocks to the basin are readily accessible for study. In 2015, geologic mapping in the region identified ancient submarine canyon complexes for the first time ever in Cook Inlet, and concurrent reconnaissance field studies have helped DGGS discover additional canyons in the proposed map area. These are important features to document and understand for many petroleum systems worldwide, as they are often connected to hydrocarbon reservoirs in deeper, offshore regions of petroleum basins given the right conditions. Cook Inlet field studies, including geologic mapping, by DGGS over the past 5 years, has provided new information to industry and the public about how and when faults and folds have developed to form potential structural hydrocarbon traps. In the planned 2017 map area, however, the character of these features changes, and understanding how and why these changes occur may provide additional insight into how the basin has deformed as a system, including currently producing structural hydrocarbon traps in the better-explored upper Cook Inlet. Within the planned map area, there is an opportunity to study some of the only gold-bearing volcanogenic massive sulfide (VMS) deposits in the Cook Inlet region.



Still cooking coal to generate hydrocarbons: An innovative research effort with the USGS

Previous investigations using Rock-Eval pyrolysis have suggested that certain coal samples from the Nenana, Susitna, and Holitna basins in Alaska may have the potential, if buried deeply enough to reach an appropriate level of thermal maturity, to generate quantities of liquid hydrocarbons. This novel research project is testing the hypothesis that Alaska coal can generate liquid hydrocarbons in the subsurface by conducting hydrous pyrolysis (HP) experiments on selected coal samples. The HP experiments were designed to replicate realistic subsurface conditions and conducted on four coal samples, two each from the Nenana basin and the western Matanuska Valley. Each sample generated a significant volume of oil. Detailed organic geochemical characterization of the generated oils is currently underway, including biomarker identification and mass balance analysis (oil yield as a function of coal maturity/rank). A remaining challenge is to evaluate the expulsion efficiency of typical Alaska coal. Results from this study will likely spur exploration interest in several frontier basins in the state.

Jarvis Creek coal samples: Populating the National Coal Resource Database System (NCRDS)

Alaska's coal resources make up about half of the United States' coal resource base. Many of Alaska's coal fields now have modern analyses to characterize coal quality parameters. This information is essential to evaluate suitability of coal for use in power generation. Less well-known is the liquid hydrocarbon potential of Alaska's subsurface coal resources. The hydrous pyrolysis (HP) project described above provides a realistic indication of a coal's ability to generate liquid hydrocarbons in the natural subsurface environment. However, HP experiments are time-consuming, require highly specialized laboratory equipment, and can only be done at one lab in the United States—the USGS's organic geochemistry laboratory in Lakewood, Colorado—which severely restricts the ability to assess the liquid hydrocarbon potential of Alaska's coal resources.

Rock-Eval pyrolysis is an inexpensive, routine, rapid analysis used to assess a rock's hydrocarbon source potential. Rock-Eval pyrolysis is routinely performed by several commercial laboratories in the United States. Unlike HP experiments, Rock-Eval analysis is carried out in the absence of water, with the result that hydrocarbons generated during analysis do not resemble compounds generated in the natural subsurface environment. Despite this limitation, this method is widely used in the petroleum industry as a screening tool for source rock potential and, when paired with coal quality data, is useful for screening samples for HP experiments.

A project was initiated in 2016 to collect a suite of coal samples from selected Alaska sedimentary basins for paired analysis of coal quality, Rock-Eval pyrolysis, and kerogen microscopy, starting with an analysis of a suite of coal samples from the Jarvis Creek coal field. The resulting data will be entered into the USGS's National Coal Resource Database System and will be entered into DGGS's digital database (see below). The Jarvis Creek samples are relevant to understanding the liquid hydrocarbon potential of the Nenana basin and provide a complementary dataset to the HP results discussed above.

Petroleum-related digital data at your fingertips: Geodatabase development continues

DGGS has accumulated a vast amount of geologic data relevant to the petroleum potential of Alaska's sedimentary basins over the past few decades, and continues to gather new data. A searchable, digital database is under construction that will allow industry and the public to search for relevant geologic data throughout the North Slope, Cook Inlet, and other frontier basins in Alaska. The initial phase consists of Cook Inlet reservoir quality data. A schema has been developed to accommodate field station data generated by the Energy Resources Section and work is underway to develop a schema for geochronology data. Readily available, relevant, petroleum-related geologic data in a digital format will help petroleum companies successfully explore for and produce hydrocarbons from Alaska's sedimentary basins, which will translate to increased revenue to the State of Alaska.

NOTABLE ACHIEVEMENTS

- Published 11 reports addressing the petroleum geology of lower Cook Inlet.
- Published three reports summarizing the reservoir potential and quality of the Nanushuk Formation in the Wainwright #1 core and its exploration significance for the central North Slope.
- Published a report documenting submarine canyons and their sequence stratigraphic and hydrocarbon reservoir significance in the Naknek Formation, lower Cook Inlet basin.
- Developed and implemented a database schema for field station information for DGGS's statewide energy-related data. Implemented the data schema for Cook Inlet field stations.
- Ran a one-day field trip highlighting Cenozoic gas reservoirs in Cook Inlet basin for the 2016 annual meeting of the Association of American State Geologists.
- Delivered two oral presentations addressing the geology of the Susitna basin and its natural gas potential for a USGS geology review meeting in support of an upcoming assessment of the undiscovered, technically recoverable oil and gas resources in the basin.
- Collaborated with the USGS to conduct hydrous pyrolysis experiments on four coal samples, including two from the Nenana basin and two from the Matanuska Valley.
- Submitted funding proposal to the USGS STATEMAP program for 4 weeks of helicopter-supported bedrock geological mapping in July 2017 in the Tuxedni Bay area in lower Cook Inlet.
- Collected suite of coal samples from the Jarvis Creek coal field for coal quality and Rock-Eval pyrolysis to evaluate the petroleum source potential of coal in the greater Nenana basin.

ENERGY SECTION PUBLICATIONS IN 2016

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Oil-stained sandstone in the Middle Jurassic lower Paveloff Siltstone Member of the Chinitna Formation: Exploring the potential role of facies variations in controlling diagenesis and reservoir quality in western Cook Inlet, Alaska, by M.A. Wartes and T.M. Herriott, 2015: Preliminary Interpretive Report 2015-7, 9 p. doi.org/10.14509/29533

Petroleum-related geologic studies in lower Cook Inlet during 2015, Iniskin–Tuxedni region, south-central Alaska, by T.M. Herriott, ed., 2016, Preliminary Interpretive Report 2016-1, 78 p. doi.org/10.14509/29532

Introduction to petroleum-related geologic studies in lower Cook Inlet during 2015, Iniskin–Tuxedni region, south-central Alaska, by T.M. Herriott, ed., 2016, Preliminary Interpretive Report 2016-1-1, p. 1–8. doi.org/10.14509/29534

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Discovery of a new sandstone with residual oil in Maastrichtian(?) strata at Shelter Creek, lower Cook Inlet, Alaska, by R.J. Gillis, 2016, Preliminary Interpretive Report 2016-1-7, p. 51–58. doi.org/10.14509/29541

Revised mapping of the Upper Jurassic Naknek Formation in a footwall syncline associated with the Bruin Bay fault system, Chinitna Bay region, western Cook Inlet, Alaska, by M.A. Wartes, R.J. Gillis, and N.T. Harun, 2016, Preliminary Interpretive Report 2016-1-8, p. 59–66. doi.org/10.14509/29542

Fracture intensity in the Paveloff Siltstone Member (Chinitna Formation) and Pomeroy Arkose Member (Naknek Formation), Iniskin Peninsula, Alaska: Implications for hydrocarbon migration in Cook Inlet basin, by J.L. Rosenthal, P.M. Betka, R.J. Gillis, and Elisabeth Nadin, 2016, Preliminary Interpretive Report 2016-1-9, p. 67–72. doi.org/10.14509/29543

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Lithofacies analysis of the Wainwright #1 continuous core, western Arctic Slope, Alaska: Transition from lower to upper delta plain environments in the Albian–Cenomanian Nanushuk Formation, by D.L. LePain and P.L. Decker, 2016, Report of Investigation 2015-2-3, p. 5–35, 1 sheet. doi.org/10.14509/29656

Sedimentary petrology and reservoir quality of Albian–Cenomanian Nanushuk Formation sandstones, USGS Wainwright #1 test well, western North Slope, Alaska, by K.P. Helmold, 2016, Report of Investigation 2016-3-3, p. 37–57, data files. doi.org/10.14509/29657

Top Mesozoic unconformity subcrop map, Cook Inlet basin, Alaska, by L.S. Gregersen and D.P. Shellenbaum, 2016, Report of Investigation 2016-4, 1 sheet, scale 1:500,000. doi.org/10.14509/29658

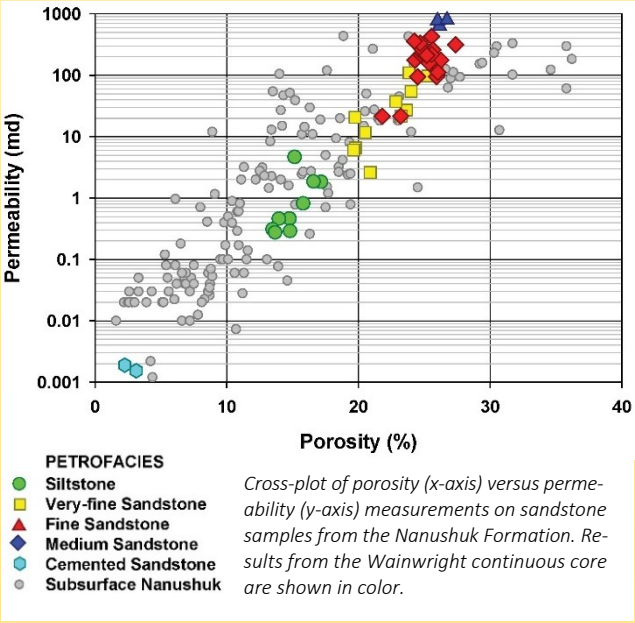
FROM ROCKS TO REVENUE:
DGGS applied research focuses on Brookian reservoir potential

With 28 billion barrels of oil equivalent discovered to date onshore, and an estimated 30 billion barrels of oil and 181 trillion cubic feet of non-associated gas in undiscovered, but technically recoverable accumulations (U.S. Geological Survey 2012 assessment), northern Alaska is one of the most prolific hydrocarbon provinces in North America. Finding and producing these resources, which are likely contained in complex, subtle stratigraphic traps, requires high-quality, detailed geologic information, including detailed reconstructions of the depositional systems that host these reservoirs.

Since 2005, funded by an investment in energy-related geologic research by the State, the Energy Resources Section has published 5 bedrock geologic maps and numerous reports, supported several relevant graduate student thesis research projects, and given several dozen presentations on the geology and petroleum potential of northern Alaska. Much of this work has focused on petroleum source and reservoir rocks in the Brookian sequence, including extensive work on the Nanushuk and Torok Formations. The Nanushuk is one of the reservoirs in the recently discovered Pikka unit and the reservoir in ConocoPhillips' Willow discovery, and the Torok is the purported reservoir in Caelus's recently announced discovery at Smith Bay. Published estimates for the Pikka unit include contingent resources ranging from 500 million (1C) to more than 3.7 billion (3C), and ConocoPhillips estimates a recoverable resource in excess of 300 million barrels of oil. Press releases by Caelus claim the Smith Bay discovery may host a comparable volume of oil in deep-water sandstones of the Torok Formation.

In 2016, DGGS released three reports summarizing the reservoir quality of nearly 1,500 feet of continuous core, obtained from the Nanushuk Formation during drilling of the Wainwright #1 well in northwestern Alaska, and discussed the Nanushuk Formation's significance for potential reservoirs in the central North Slope. Relevant reports such as this in the public domain literature spur exploration investment and development success by providing unique, high-quality, relevant information that helps to reduce exploration risk. More data such as this are urgently needed to promote discovery and production of hydrocarbon resources in northern Alaska.

Core photograph showing permeable sandstone in the Nanushuk Formation from a depth of 1,097 feet to 1,121 feet in the Wainwright #1 well. The large round holes extending through the core resulted from cutting cylindrical-shaped plugs used for laboratory measurement of porosity and permeability. Photograph courtesy of the U.S. Geological Survey.



Cross-plot of porosity (x-axis) versus permeability (y-axis) measurements on sandstone samples from the Nanushuk Formation. Results from the Wainwright continuous core are shown in color.

ENGINEERING GEOLOGY SECTION

Determines the potential geologic hazards to buildings, roads, bridges, and other installations and structures, and the locations and supplies of groundwater and construction materials.

BENEFIT TO ALASKA

In many areas, Alaska 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 natural hazards events. Maps and reports produced by the Engineering Geology Section are the front-line source of information about where damage is likely to be greatest and where mitigation efforts should be concentrated. Engineering-geologic maps depicting construction materials resources are useful for building infrastructure to support resource exploration and development, and for locating valuable placer-mineral deposits. Groundwater analysis and aquifer modeling and mapping in oil and gas basins and other areas of high development potential are essential to ensuring an adequate and safe supply of water for development and resource access.

Gabriel Wolken, De Anne Stevens, Trent Hubbard, Ronald Daanen, Jacquelyn Overbeck, Katrina Kennedy

MAJOR PROGRAM ELEMENTS

- Geologic Hazards
- Geohydrology
- Geologic Mapping
- Construction Materials Resources
- Climate and Cryosphere
- Coastal Processes

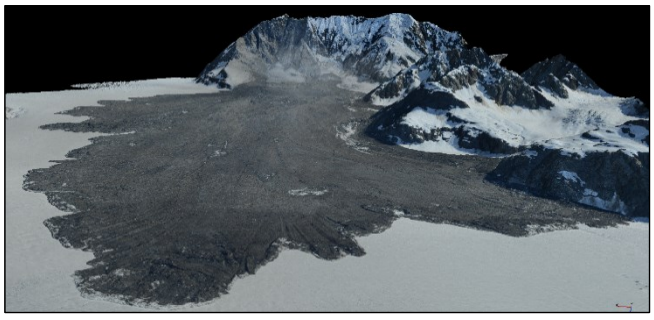
MAJOR ACCOMPLISHMENTS IN 2016

A mountainside collapses: Time-critical data acquisition and analysis of the 2016 Lamplugh Glacier ice-rock avalanche

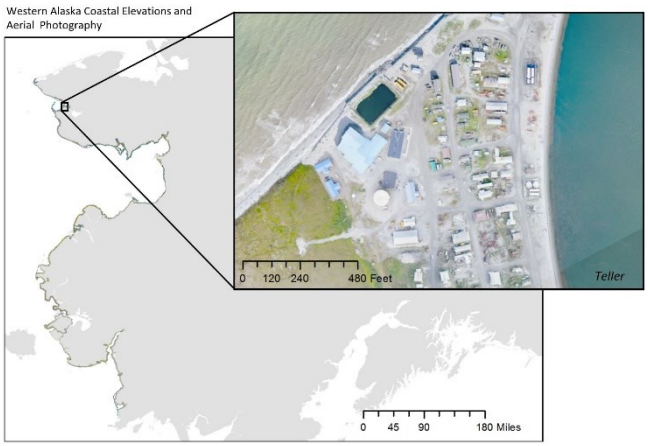
On June 28 the largest landslide on Earth in 2016 occurred in Glacier Bay National Park, southeastern Alaska, when the side of a 4,000-foot-high mountain collapsed and spread ice and rock debris for 6 miles along the surface of Lamplugh Glacier. This event was so powerful that it registered on seismometers as though it were a magnitude 5.2 earthquake.

DGGS's Climate and Cryosphere Hazards program responded immediately with airborne remote sensing equipment to acquire time-critical detailed aerial photographic data to map the deposit and evaluate the potential for any additional hazard. The image data and derived digital surface models allowed DGGS and collaborators from the University of Northern British Columbia and Columbia University to conduct a precise analysis of the extent and volume of the ice-rock avalanche and better understand how and why this slope failure occurred.

In addition to the 2016 event, the outer St. Elias Mountains have experienced several large, world-class-size ice-rock avalanches in recent years. Lamplugh Glacier terminates in John Hopkins Inlet—a popular stop for cruise ships—and had the landslide reached the ocean it could have generated an immense local tsunami



that would have posed a significant hazard to marine vessels in the area. While the exact cause of the region's ice-rock avalanches is still unclear, regional climate warming and proximity to the active Fairweather Fault suggest that tectonic stresses, glacier debuttressing (exposure of glacially steepened rockwalls due to thinning and retreat of glacier ice), and permafrost degradation may have set the stage for slope failure. The Lamplugh Glacier ice-rock avalanche provides an important opportunity to study how geology, tectonics, and environmental change affect slope stability, and the results will help DGGS scientists and collaborators assess landslide hazards and risk in other regions of Alaska with similar slope conditions.



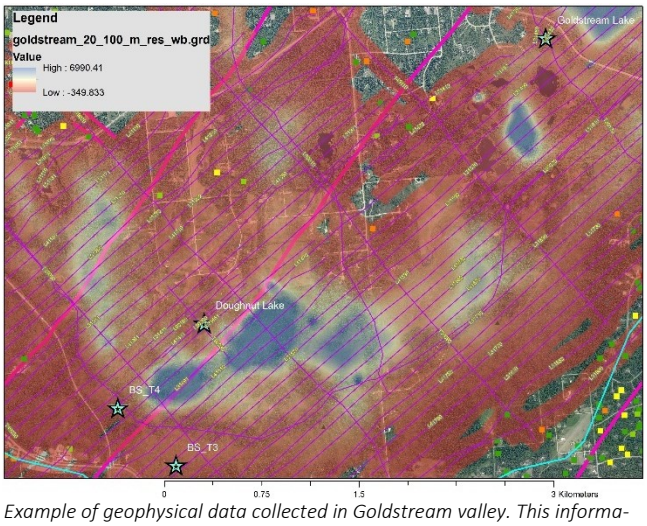
Narrowing the baseline data gap: Decision support for Alaska's coastal communities

Assessing geologic hazards that threaten coastal communities of Alaska must begin with solid baseline data in the coastal region, which continues to have large gaps in data coverage. DGGS is working to enhance the quality and spatial coverage of this critical data by installing a series of new water-level sensors in coastal communities to monitor and document tides and storm events. The water-level sensors, called "iGages", were developed by the National Weather Service Alaska River Forecast Center and funded by the Alaska Ocean Observing System, and DGGS is collaborating closely with both entities to conduct this work. In 2016 the first iGage was installed in Dillingham to collect water-level data in Bristol Bay. Unfortunately, our second iGage, deployed to Kaktovik on the Beaufort Sea coast, was vandalized before it could transmit any significant data. These efforts supplement 2015–2016 coastal elevation and aerial photography data covering a large swath of western Alaska, which are now being combined with U.S. Geological Survey aerial photography from the 1950s and 1980s in an interagency effort to recognize trends, identify relevant hazards, plan for hazardous events, and forecast potential hazards such as flooding and erosion. The resulting high-resolution data products have the detail necessary for determining where the current shoreline boundary is and identifying relative hazards on a structure-by-structure basis.

Frozen ground and liquid water: Permafrost–groundwater interactions in a changing world

DGGS's Geohydrology program is actively pursuing new ways to better understand groundwater resources in Alaska and the impacts of changing climate. In collaboration with the University of Alaska Fairbanks DGGS is conducting two major projects funded by the National Science Foundation to explore the interaction of permafrost and groundwater. Emerging new evidence from a North Slope project suggests that smaller streams impacted by permafrost degradation are significantly affecting winter discharge. Additional water is being released into the system and is increasing the potential for wintertime flooding and icings (overflow) on the Dalton Highway. While this can negatively impact infrastructure, this increase in discharge is also a potential source of water for use by industry during the winter dry season.

Another large research project, now in its second year, aims to understand groundwater movement in Goldstream valley, a populated area of discontinuous permafrost just north of Fairbanks. In 2016 DGGS successfully completed a campaign to collect airborne geophysical data for the valley to help visualize frozen ground in new ways. The partially processed data



Example of geophysical data collected in Goldstream valley. This information will feed into the development of a three-dimensional permafrost map that will help guide development planning and answer scientific questions about permafrost, groundwater, and greenhouse gases.

is now being refined and will lead to a unique three-dimensional permafrost map of the valley that can help homeowners, planners, and others understand the distribution of frozen ground and mitigate potential impacts on the built environment. This map will also be used to help answer many important scientific questions, including: What does the future hold for groundwater resources in the hills around Fairbanks?, What can we learn about the base of the permafrost and the rate of thaw since the last ice age?, and What will happen as enormous carbon stocks locked deep inside the frozen sediment are released by thawing permafrost and contribute greenhouse gases to the atmosphere?

The best defense: Mapping and modeling landslide hazards for Sitka community planning

Recent fatal landslides, such as the August 2015 Sitka slides, are sobering reminders of the dangers of geohazard events and highlight the need for good geologic information in areas of potential risk. In an effort to help guide planning and emergency response preparation in Sitka, DGGS successfully secured funding in 2016 from the Federal Emergency Management Agency (FEMA) to assess and map landslide hazards for the developed areas around the community. In summer 2016, DGGS collaborated with the U.S. Army Corps of Engineers Cold Regions Research and Engineering Lab (CRREL) and the Sitka National Historical Park (National Park Service) to conduct a helicopter-borne lidar campaign, which collected, and will make publicly available, digital elevation data of the post-landslide landscape. Existing information available to the U.S. Forest Service and City of Sitka is now being combined with DGGS May 2016 field observations. Interpretation of historical image data and older and new lidar-derived surface elevation data will help produce new maps identifying existing landslide deposits and associated features. Once these landslide inventory maps are completed, the digital data will be combined with additional DGGS field data—augmented by data collected by on-the-ground Sitka citizen-scientists coordinated by the Sitka Sound Science Center—to produce a community landslide susceptibility map and to guide runout modeling of hypothetical future landslides. The completed maps will provide the critical information needed by the City of Sitka and its residents to prepare for potential landslides and wisely plan future development. The digital data produced will also be used by the FEMA Multi-Hazards Risk MAP program as input for its Hazus hazards models, part of a Federal effort to help communities prepare for, mitigate, and be resilient in the face of natural disasters.

NOTABLE ACHIEVEMENTS

- Provided expertise in support of coastal resilience and hazard preparedness for vulnerable communities in western Alaska. Key activities include participating in regional Coastal Resilience and Climate Adaptation workshops held by Alaska-region Landscape Conservation Cooperatives (LCCs; Western Alaska LCC, Aleutian and Bering Sea Islands LCC, and the North Pacific LCC); and collaborating with the University of Alaska and Bristol Bay Native Association to develop novel methods for local residents to monitor erosion in their communities.
- Completed a major project to collect high-resolution aerial image and elevation data for 2,200 miles of Alaska's western coast, including 29 communities. This is a substantial contribution to the amount of high-quality baseline coastal data available in the state and will provide critical information needed for geohazard mapping, community planning, and emergency response.
- Developed and refined Structure-from-Motion (SfM) aerial photography equipment and field data collection protocols, and have effectively deployed this tool on short notice for emergency, rapid-

response, and other high-priority projects, including: Alaska Range, Valdez ice-dammed lake, Richardson Highway/Thompson Pass, Mt. Redoubt, Sitka, Haines Highway, and Suicide Basin/Juneau.

- Continued to manage the DNR portion of the federally-funded National Tsunami Hazards Mitigation Program. Inundation maps showing areas that could be affected by future potential tsunamis were published for Dutch Harbor, Akutan, King Cove, Cold Bay, Yakutat, Nikolski, Chignik, and Chignik Lagoon. Results of these investigations have been disseminated to local emergency planners.
- Submitted to Alaska Energy Authority (AEA) the Final Study Report of glacier and runoff changes for the proposed Susitna–Watana Hydroelectric Project. The report and data are now being prepared for formal publication through DGGS.
- Published a preliminary report that included surficial geologic mapping for the Talkeetna Mountains C-4 Quadrangle (near the proposed Susitna–Watana hydroelectric project) and adjacent areas at a scale of 1:50,000. Surficial mapping in combination with bedrock geology mapping was part of a STATEMAP project serving DGGS's mission to provide important geologic information in areas of increased public interest.
- Published surficial-geologic report and map of 875 square miles in the Tyonek area, western Cook Inlet. The northwestern Cook Inlet trough is rich in petroleum, coal, geothermal, aggregate, and timber resources, but the detailed geologic mapping necessary for planning future resource development previously existed for only part of the area.
- Worked with the Alaska Department of Transportation & Public Facilities (DOT&PF) to evaluate an area of slope instability along the Richardson Highway between MP 80 and 82 near Tonsina. Data and reports will provide information to the public and be utilized by DOT&PF for decision-making and infrastructure repair and maintenance.
- In partnership with Alaska Ocean Observing Systems (AOOS) and the National Weather Service Alaska Region, enhanced coverage of water-level networks through installation of new real-time water-level sensors throughout western Alaska.
- Worked with DOT&PF avalanche professionals, University of Alaska, and USGS on innovative, state-of-the-art snow distribution and avalanche studies in south-central Alaska.
- Published annual report on the state of glaciers and ice caps in the Arctic, as part of the Bulletin of the American Meteorological Society's *State of the Climate* report. This international report is considered the "annual physical" of Earth's climate system and is circulated and cited worldwide.

ENGINEERING GEOLOGY SECTION PUBLICATIONS IN 2016

Tsunami inundation maps for Alaska communities, by J.T. Newell, S.A. Maurits, E.N. Suleimani, R.D. Koehler, and D.J. Nicolsky, 2015, Digital Data Series 10. doi.org/10.14509/29523

Alaska Shoreline Change Tool, by DGGS staff, 2015, Digital Data Series 9. doi.org/10.14509/29504

Guide to projected shoreline positions in the Alaska Shoreline Change Tool, by A.I. Gould, N.E.M. Kinsman, and M.D. Hendricks, 2015, Miscellaneous Publication 158, doi.org/10.14509/29503

Photogrammetric digital surface models and orthoimagery for 26 coastal communities of western Alaska, 2016, by J.R. Overbeck, M.D. Hendricks, and N.E.M. Kinsman, Raw Data File 2016-1, 3 p. doi.org/10.14509/29548

Tsunami inundation maps of Fox Islands communities, including Dutch Harbor and Akutan, Alaska, by D.J. Nicolsky, E.N. Suleimani, J.T. Freymueller, and R.D. Koehler, 2015, Report of Investigation 2015-5, 67 p., 2 sheets, scale 1:12,500. doi.org/10.14509/29414

Surficial geology of the Tyonek area, south-central Tyonek Quadrangle, Alaska, by R.D. Reger, D.S.P. Stevens, and R.D. Koehler, 2015, Report of Investigation 2015-7, 38 p., 1 sheet, scale 1:63,360. doi.org/10.14509/29471

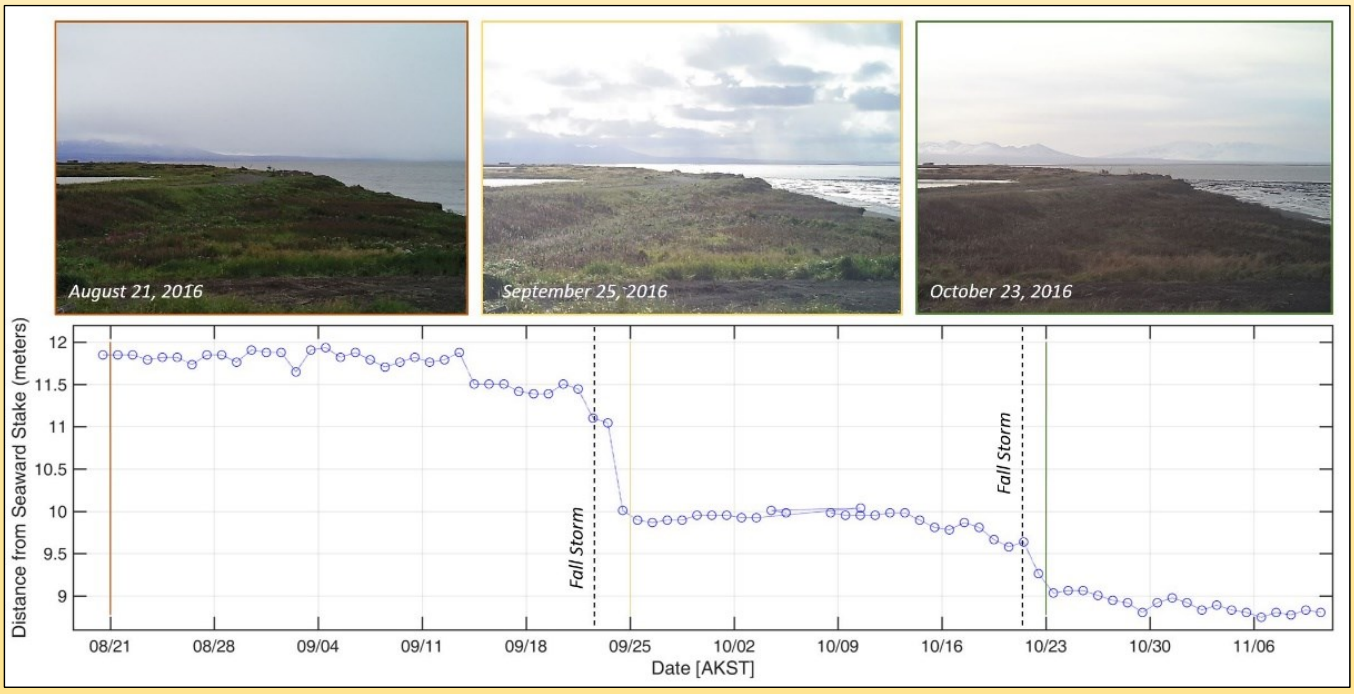
Tsunami inundation maps for Yakutat, Alaska, by E.N. Suleimani, D.J. Nicolsky, and R.D. Koehler, 2016, Report of Investigation 2016-2, 47 p., 1 sheet, scale 1:10,000. doi.org/10.14509/29577

Preliminary evaluation of bedrock potential for naturally occurring asbestos in Alaska, by D.N. Solie and J.E. Athey, 2015, Miscellaneous Publication 157, 15 p., 21 sheets, scale 1:500,000. doi.org/10.14509/29447

STAKES FOR STAKEHOLDERS: Community-based shoreline erosion monitoring

Erosion is an imminent threat for many of Alaska's coastal, riverine, and lakeside communities, and mitigation is an expensive challenge for small, often cash-strapped, settlements. Erosion rate estimates are required to qualify for certain kinds of federal or state assistance, but data about historical events and long-term rates of change are often sparse. To address the need for local estimates of erosion rates, DGGS's Coastal Hazards Program is teaming up with the University of Alaska Fairbanks, Bristol Bay Native Association, and the Aleut Community of St. Paul Island to develop a program for community-based monitoring of shoreline change. These efforts, funded by Alaska Sea Grant and the Bureau of Indian Affairs, take advantage of inexpensive and easy-to-use equipment along with local volunteers and environmental program staff to collect data at the water's edge. Local observers utilize time-lapse cameras in conjunction with stakes set back from the coast in precisely measured locations to monitor the position of an eroding bluff edge, riverbank, or coastal feature through time. Local observers also use "Emery rods" in a simple method similar to rod-and-transit survey to measure the changing topography of the beach throughout the seasons and before and after storm events.

In 2016 project participants from around Bristol Bay attended a two-day workshop in Dillingham to learn about shoreline change and how to use monitoring equipment, and to share personal observations of environmental change. The workshop was followed by site visits to Port Heiden, Togiak, and Levelock, where open community meetings were held and



Position of a bluff edge at Port Heiden, shown as distance from a stake through time. Fall storms eroded 3.05 meters (about 10 feet) of bluff over one storm season.

equipment was calibrated using a high-grade, differential global positioning system (GPS). After a stormy fall, photographs already reveal erosion at multiple sites. Next year, the team will install sites at four more communities and water-level sensors at two lake communities. Informational material and program guidelines are also being developed to give other communities along Alaska's waterlines access to these monitoring methods.

The project will provide the data necessary to help qualify for federal and state assistance and to meet project-lifespan engineering requirements in the design and siting of construction projects. Data from these efforts will not only contribute to a statewide database for tracking shoreline positions (maps.dggs.alaska.gov/shoreline/) and rates of shoreline change, but will also give community members a sense of ownership and an understanding of important shoreline processes.

Project Team:

Jacquelyn Overbeck, Alaska Division of Geological & Geophysical Surveys
Chris Maio, University of Alaska Fairbanks
Richard Buzard, Graduate Student, University of Alaska Fairbanks
Gabe Dunham, Alaska Sea Grant Marine Advisory Program, University of Alaska Fairbanks
Sue Flensburg, Bristol Bay Native Association

GEOLOGIC COMMUNICATIONS

Ensure fast, easy public access to Alaska's geologic data; develop and serve geologic data products that answer questions about Alaska's resources, natural hazards, and land management issues.

BENEFITS TO ALASKA

Information availability creates value: Geologic information about Alaska's resources helps to inform land-management decisions and encourage investment, exploration, and development of the state's resources, resulting in billions of dollars of impact to Alaska's economy.

Protects lives and reduces property damage: Availability of information specific to the state's volcanoes, earthquakes, landslides, tsunamis, coastal erosion, climate change, and other natural hazards helps mitigate geologic hazards, helping to save lives and reduce damage to property and critical infra–structure.

Clockwise, from top left: Trish Gallagher, Mike Hendricks, Jen Athey, Linda Natrop, Ken Woods, Bobby Kirchner, Paula Davis, Susan Seitz, and Simone Montayne. Not pictured: Kara Lewandowski, Chris Ramey.

MAJOR PROJECTS

- Create online geospatial applications for efficient delivery of geologic data
- Continuously develop and maintain Alaska's geologic data repository
- Publish geologic information (maps, reports, digital data)
- Maintain and develop DGGS's computing resources
- Account for and maintain critical field safety and communication equipment

OUR AUDIENCE

The section provides and maintains access to scientific information for private industry, agencies, researchers, and individuals; provides easy-to-understand information to non-scientists, through personal contact, paper, and digital media.

- Tourists visit our office for road guides and to browse our rock and fossil displays.
- Private citizens contact us about geologic hazards on personal property, such as sinkholes and permafrost distribution.
- Artists inquire about locations of carving stones, gemstones, and pottery clay.
- Teachers contact us for curriculum materials.
- Rock-hounds ask about collecting sites for rocks, fossils, and minerals.
- Miners request instruction in how to use maps and geophysical data to find gold.
- Exploration companies seek our analytical data to look for resources.
- State agencies require our information for land-use plans and construction projects.
- GIS users rely on us to provide high-resolution elevation data, digital geologic maps, and other geospatial data.
- Researchers and exploration geologists investigate mineral occurrences or technical observations recorded in our archive of historical data.

OVERVIEW

What keeps us up at night: The digital backbone of DGGS

Provide public access to information by developing and delivering publications, web-based data, and online applications. The section's staff design, edit, refine, publish, and deliver Division-generated geologic information as authoritative, peer-reviewed

maps, manuscripts, geospatial datasets, and easy-to-use online applications. In FY16, the section's publication, GIS, and cartographic services enabled geospatial data analysis and map publication for almost 28,000 square miles of new geologic mapping and airborne geophysical data.

Archive and provide user-friendly access to digital and map-based geological, geophysical, and geochemical data from a Division-wide database the section designed, created, and continues to maintain. The database includes about 165 terabytes of geologic information, which equates to many billions of pieces of important and useful information about Alaska's geology. The database drives DGGS's website (dggs.alaska.gov), which received almost 36.9 million page views in FY16.

Provide Information Technology (IT) services for the Division to facilitate data exchange and ensure efficient use of computing resources. The reliable, heavily used network and multiple databases use free, open source software combined with in-house programming instead of costly packages and hardware. They also maintain individual computer resources and peripherals, along with field safety and communication equipment necessary to safely conduct geologic research in remote areas.

ACCOMPLISHMENTS

User-friendly, interactive web maps: New additions

The Geologic Communications Section continued to add web applications to make data easier to obtain and use. The coding behind our popular Elevation Datasets in Alaska is being upgraded to handle far more queries than we initially expected, and to add the capability of directly viewing orthoimagery. DGGS is also further improving data accessibility using GIS services—eliminating the need for users to directly download the data—and providing them with the most up-to-date versions of geospatial data. This also allows advanced users to interact with the data using GIS functions and other analysis toolsets.

During 2016, DGGS added an interactive Alaska Shoreline Change Tool, so that coastal residents and researchers can more easily access historic and predicted future shoreline positions for Alaska. It complements our Alaska Coastal Profile Tool, which provides visualizations of beach elevation profile measurements collected in Alaska since the '60s. The section continues to upgrade and develop new applications to increase options to access the information collected and analyzed by geologic staff. DGGS geospatial online applications are available at maps.dggs.alaska.gov.

Solving problems with agency collaboration: Online geology map will inform Alaskans about radon-generating areas

DGGS was awarded almost $300,000 in funding from the EPA Environmental Information Exchange Network for a 3-year radon and geology project to create an online application that shows Alaska radon test data and corresponding radon-generative geologic units. Radon is a radioactive colorless, odorless, tasteless gas that has been linked to lung cancer in patients who have been exposed to it via inhalation, and is a public health concern in Alaska. Radon gas, a decay product of naturally occurring radioactive elements in many types of rock, can percolate through fractured rock and soils and accumulate in structures.

Because geologic information is essential to environmental analysis and decision-making, it can be used in many facets of environmental sciences by multiple agencies. As part of this project, a committee of geologists and GIS professionals from nine states, USGS, and Geological Survey of Canada, led by DGGS, are developing enterprise-scale database standards for geologic-related organizations to make geologic data more accessible to the EPA and other agencies needing these data.

A database of Alaska radon test data will be compiled with cooperation from the University of Alaska

Fairbanks Cooperative Extension Service and delivered to the EPA to ensure state and federal agencies have access to high quality, timely, standardized information. Data standards and a growing repository of test data will allow more robust scientific modeling, epidemiological studies, and new public outreach materials on a local and national scale to reduce radon exposure risk and ensure positive outcomes for Alaskans.

Output: Publications and applications that bring you geology you can use

The Section published 36 new publications comprising 949 pages of information, 76 map sheets, 15 digital geospatial data packages, and three online applications, and created eight posters/presentations. The publications contributed 27,842.5 square miles of new geologic mapping and newly acquired airborne geophysical data. The DGGS website saw 36.9 million page views, 11,301 downloads of digital geospatial data, and 895,647 downloads of publications in FY16.

We added more data to our online applications:

Elevation Datasets in Alaska (maps.dggs.alaska.gov/elevationdata/)	
LiDAR (~1,360 sq mi)	**square miles**
Anchorage 2015	835.0
Arctic Coastal Plain 2013	164.0
Bradfield–Behms (Roads2Resources [R2R])	11.6
Juneau R2R	7.7
Kaltag	8.1
Kotzebue Sound North	105.0
Koyukuk	5.4
Nulato	5.0
Tanana Forest Inventory	67.6
Okmok	149.4
IfSAR	
15 cells	23,705.5
Structure-from-Motion (SfM) elevation data	
Western Alaska Coastal Community Project	181.1
TOTAL SQUARE MILES ADDED:	**25,064.3**

NOTABLE ACHIEVEMENTS

Data made available

- Published 8 new geochemistry publications, leading to 983 new sample analyses loaded into the Webgeochem online application, which is undergoing updates to make it more robust and able to deal with much larger queries.
- Rescued irreplaceable, high-value, and/or unpublished energy-related project materials produced by former DGGS geologists Gil Mull and Ellen Harris, funded by USGS National Geological & Geophysical Data Preservation Program (NGGDP). Created 283 Alaska Geologic Data Index (maps.dggs.alaska.gov/agdi/) records of field notes and unpublished maps from Alaska, digitized 7,465 field station locations, and scanned 319 maps and 114 field notebooks for archiving. Also added 476 new records of general geologic archive material to the database.
- Alaska Geologic Map Index interactive web map (maps.dggs.alaska.gov/mapindex/): Added the entire series of fixed-wing aeromagnetic survey maps (519 maps) produced between 1970 and 1975.

Practical geology

- Responded to nearly 100 email, mail, phone, and front desk inquiries for information about geologic maps, data, rock and mineral identification, and geologic hazards.
- Presented information about arsenic in groundwater at four Fairbanks-area community meetings in March and April 2016 in cooperation with the Department of Health and Social Services, Department of Environmental Conservation, and others. Created handout, *Naturally Occurring Arsenic in Interior Alaska Ground Water*.
- Provided placer geology and gold panning lessons to Fairbanks preschool and daycare July 20, 2016. Lent fossils to the school for a lesson on teeth during March 2016. Engaged school children in geology-related activities for Earth Day at Fort Wainwright April 26, 2016.

New projects

- Began work on a USGS NGGDP-funded project to scan and archive ~7,000 slides photographed by former DGGS geologist Gil Mull. The slides are related to the exploration and subsequent discovery of the Prudhoe Bay oil field. The publicly available online photo database application will preserve DGGS field photographs and their contextual information and will be completed in 2017.

Behind the scenes

- Loaded and quality controlled 7,372 field station locations from long-ago field projects into DGGS's division-wide database. These locations will provide context for thousands of physical samples stored

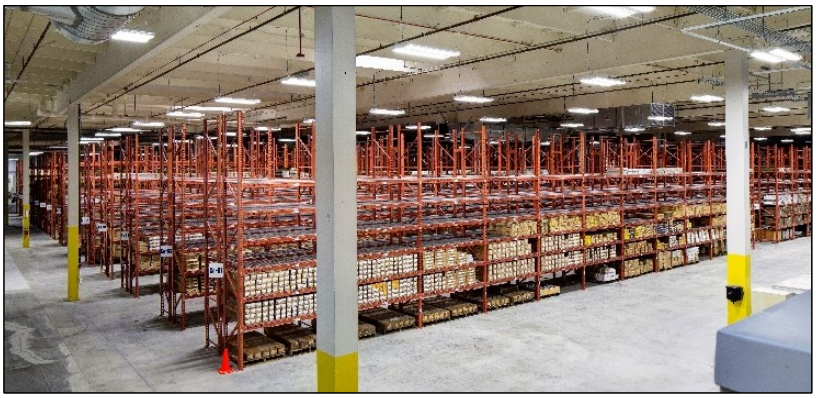
at the Geologic Materials Center that currently have little or no identifying information.

- Created material for and taught multiple cartography courses and workshops for DNR staff, saving valuable Department training funds so that they could be applied to higher-level workshops taught by an ESRI cartographer.
- Assisted Division of Forestry in resolving GIS image data issues. Collaborated with several other DNR divisions to spread our knowledge of system design, operations and maintenance, eliminating their need for expensive external support contracts.
- Began our Oracle-to-PostgreSQL application conversion, a collaborative project among DGGS's Analyst/Programmers. PostgreSQL is a free, yet very robust, open-source database program and the conversion will save the division the annual cost of an Oracle subscription.
- Set up a mass storage system for Division of Oil and Gas to serve industry-acquired seismic data that becomes available to the public once the proprietary period has expired. Saved millions of dollars by doing the setup in-house and tapping the broad expertise of our Systems Administrator.

ALASKA GEOLOGIC MATERIALS CENTER

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.

BENEFIT TO ALASKA



Alaska is home to world-class discovered and undiscovered natural resources. The cores and samples stored at the Alaska Geologic Materials Center (GMC) provide baseline geologic data and are critical for resource management and exploration in the state. The information they provide will likely help discover new and additional oil and gas reserves, viable geothermal energy regions, or new mineral prospects, as they have in the past. One foot of core can provide critical information to an exploration or development company, potentially leading to discovery and ultimately to millions of dollars in revenue to the State as well as hundreds of local jobs.

Alexandra Busk, Walter Zimmerman, Jean Riordan, Kurt Johnson

OVERVIEW

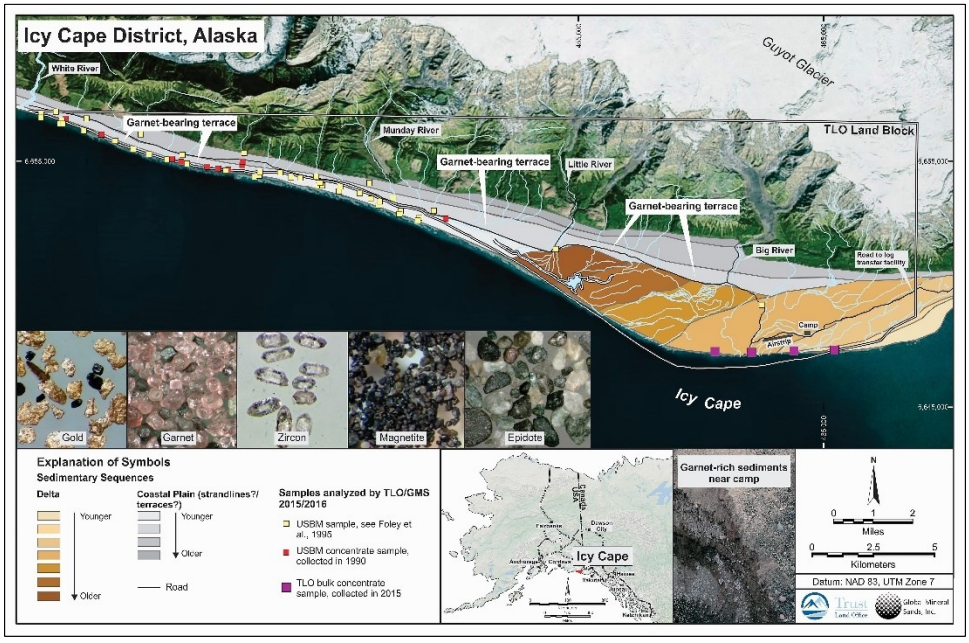
The GMC is the State's largest and most comprehensive archive of geologic samples from offshore and Federal, State, and private lands. It is the key entity directed to help industry, academia, and the public understand Alaska geology through the acquisition and preservation of physical and digital collections for future generations, assisting in the discovery of energy and mineral resources, and public outreach programs to illustrate the stories behind the science.

The GMC is operated by DGGS. Cooperative partnerships with State and federal agencies have centralized collections from the U.S Bureau of Land Management (BLM), U.S. Geological Survey (USGS), U.S. Bureau of Ocean Energy Management (BOEM), former agency U.S. Bureau of Mines (BOM), and Alaska Oil and Gas Conservation Commission (AOGCC) into one repository. Grants from the National Geological and Geophysical Data Preservation Program (NGGDPP) have aided the GMC in ongoing tasks of completing inventories and generating a more comprehensive public geologic collections database.

ACCOMPLISHMENTS

Bringing light to resources: Industry successes continue to progress

Geologists from independent and major energy companies visited the GMC to examine hundreds of feet of well core and cuttings. With declining production from the mature Prudhoe Bay oil fields it is essential to diversify the oil industry in Alaska. The GMC hosted visits by major and independent oil companies operating in both the North Slope and Cook Inlet regions, including Conoco Phillips, Hillcorp, Glacier Oil & Gas, NANA WorleyParsons, Nordaq Energy, U.S. Geological Survey, and U.S. Bureau of Ocean Energy Management.



Map showing locations of analyzed samples and sedimentary sequences in the eastern Icy Cape district. Illustration courtesy of Trust Land Office and Global Mineral Sands, Anchorage, Alaska.

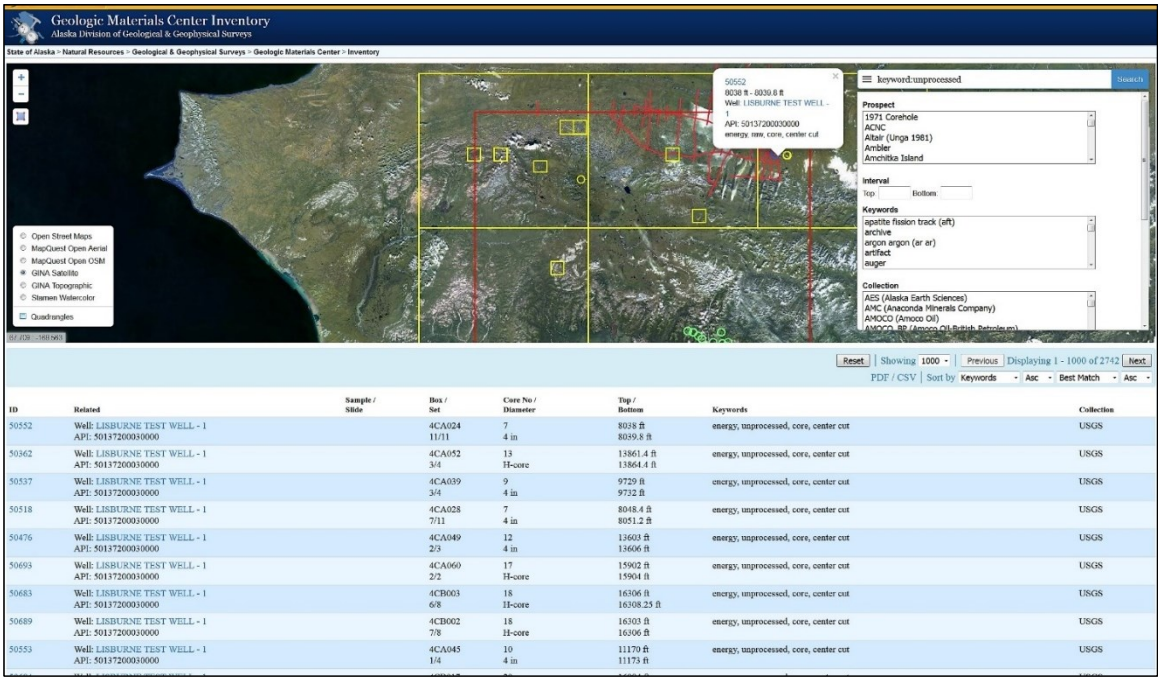
Sustaining the GMC and future growth

DGGS will be challenged to secure funding to ensure the facility continues to operate, grow, and serve long into the future. To meet this challenge, DGGS plans to institute fees for facilities, equipment, products, and services at the GMC beginning Spring 2017. This will be an adjustment for the facility's users, but the fees would help offset increased operational costs of the newly renovated, larger facility and benefit the public by improving sample accessibility and ensuring a higher quality and increased number of services provided. The bill, Ch27 SLA2016 (SB 170), signed by Governor Bill Walker on June 22, 2016, modified statute AS 41.08.030 ("Printing and Distribution of Reports"), includes a new section AS 41.08.045 ("Fees for facilities, equipment, products and services [added] to the statutes governing the DGGS"), and gave DGGS the authority to go forward with a regulation project. There are more than 28 core repositories in the U.S. and Canada, and of the ten facilities larger than 25,000 square feet in size, seven have instituted a fee schedule. The proposed fees at the Alaska GMC (100,000 square feet) are in the middle of the price range compared with these other repositories. DGGS will be inviting input from members of industry, academia, and the public regarding the planned fees in early Spring 2017.

Several major exploration successes over the last year for the energy and mining industries had their roots in the GMC sample archives. Since entering Alaska in 2011, Repsol USA and Armstrong Oil and Gas utilized North Slope drill samples stored at the GMC to support petroleum exploration that resulted in the subsequent recent discoveries of multiple reservoirs that may produce 120,000 barrels of oil per day. Bill Armstrong, owner of Armstrong Oil and Gas, stated in the Alaska Dispatch News that "there's a lot of running room" for further exploration around the new Nanushuk Formation play.

GMC sand samples collected near the Icy Cape region of southeastern Alaska were used to provide preliminary evidence for tens of billions of dollars of potentially economically recoverable heavy minerals on Alaska Mental Health Trust lands. The Trust Land Office evaluation of the GMC "heavy" sands found potential for industrial heavy minerals placers such as garnet, zircon, rutile, ilmenite, magnetite, and epidote as well as the potential for gold placers as co- or by-product. After 2016 field work, initial estimates suggest the district may contain in excess of 1.7×10^9 tons resource-bearing sediments with valuable heavy minerals averaging nearly 8 percent. The TLO and DGGS conducted proprietary high-resolution aeromagnetic surveys of the district in 2016 while resource drilling campaigns are planned for 2017.

Governor Bill Walker signs SB 170 at the Geologic Materials Center.



Finding a black cat in a coal mine: Sample accessibility boosted by new inventory database and barcodes

An integral part of the GMC is its robust database. Using barcodes and scanners, the system tracks each step of each piece of inventory as it is organized, audited, and displayed for visitors. Early this year the GMC released a public, searchable web map for more than 590,000 samples in its inventory. The browser-based tool (maps.dggs.alaska.gov/gmc) lets users build simple or complex queries through a combination of Google-like text searches, dynamic user-defined boxes, map-based regions, and drop-down text filters. Each inquiry generates a search-specific URL that can be sent to GMC staff or colleagues to exactly replicate the user's inventory results. User search results can be easily transformed into downloadable PDF or plain-text CSV files.

Rock boxes shepherded home: GMC's ongoing sample curation effort

Concern for sample and box degradation is greatly reduced at the new, temperature-controlled facility, and damaged boxes are now curated on an as-needed basis. Significant time and resources previously spent stabilizing physical samples have now shifted to researching the thousands of samples without geolocations and geologic metadata. This lack of information makes the effective use of these samples exceptionally difficult for the geologic community. Federal grants, such as the USGS-sponsored NGGDPP, are an important component of ongoing GMC goals to provide orderly and well documented samples to the public. Surface samples will continue to be an area of vital inventory and research. One of the exciting byproducts of curating the surface samples was the uncovering of thousands of megafossils that had been boxed up for decades. This study will ultimately lead to Alaska biostratigraphic reference collections and possible new insights into Alaska's geologic history.

Upper Jurassic plant fossil (Naknek Formation) from the Alaska Peninsula (Detterman's locality 80ADt237). Little is known regarding the Upper Jurassic flora of Alaska; this is only the second photo ever taken. We hope to use it to learn more about the food sources available to the dinosaurs in the Chignik Quadrangle.

Basin education on core observations: University of Alaska Anchorage students put on core workshop

This year, public outreach at the GMC was highlighted by the third annual core study and public workshop organized by Dr. Jennifer Aschoff, UAA Associate Professor of Geology. These stratigraphy labs are designed to challenge and extend the scientific capabilities of junior to graduate-level geology majors. Studies progress from hands-on experience analyzing hydrocarbon source and reservoir rocks to advancing professional collaborative skills through interaction with geologic professionals. The classes expose students to rock units from Alaska's North Slope and Cook Inlet basin. Core from multiple wells are utilized in the exercises to observe sedimentary rocks and use sedimentary structures, fossils, and rock compositions to determine likely depositional environments.

To complement the analytical skills, students present their results to members of the public and geologic community. The final open house allows students to present and defend their observations and conclusions in a poster session with judges from local institutions.

Believe you can and you're halfway there!
…and the donations roll in!

With the staff and core from the former building barely settled into the 100,000 square-foot Anchorage facility, the new repository surpassed the 50-percent-full mark this year. Total collection volume has increased more than 25 percent over the last three years.

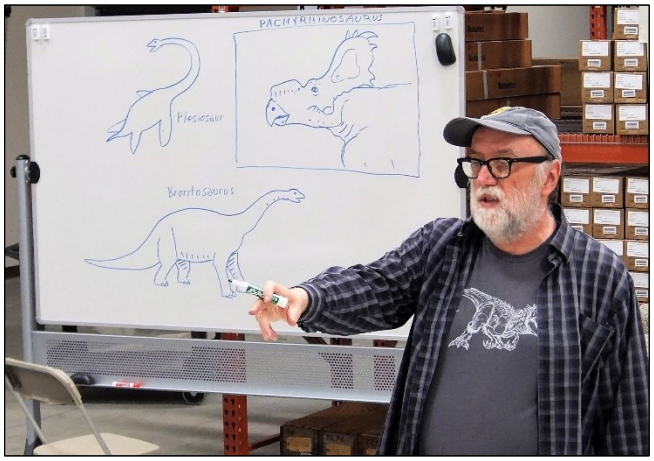
Significant new donations from the oil and gas and mining industries, state agencies, Alaska Native corporations, and engineering firms continue to pour into the warehouse. This year, BP Exploration (Alaska) donated more than 3,600 oil and gas boxes

Core was rescued from this connex at Jonesville, near Point Woronzof.

and added 238 new wells to the GMC energy collections. Mining industry donations in 2016 from Alaska Energy Authority, Calista, Kinross Gold, Millrock Resources, Online Exploration, Pure Nickel, and Riversdale Resources added more than 71,000 feet of contiguous and skeletonized mineral, engineering, and energy core from 67 boreholes to the GMC collection. Smaller additions include more than 1,100 fossil samples from the Ann Pasch Collection of the BLM Bering Glacier Invertebrate Fossil Project (1998–2006) and 1,000 USGS 1960s-era east-central Alaska outcrop samples from the Earl Brabb collection. Economic pressure often forces both private and government agencies to dispose of their geologic samples to cut storage fees. Donating samples to the Alaska GMC for public use is a responsible alternative to discarding invaluable geologic information.

Troll bridges science chasm with kids

Students from the Eagle River Boys and Girls Club took an art class from renowned Alaska natural history artist Ray Troll. Mr. Troll utilized drawings of creatures ancient and modern to inspire students to



Renowned Alaska natural history artist Ray Troll used his artistic skills to teach local children about ancient and modern creatures and to help open their minds to the world around them.

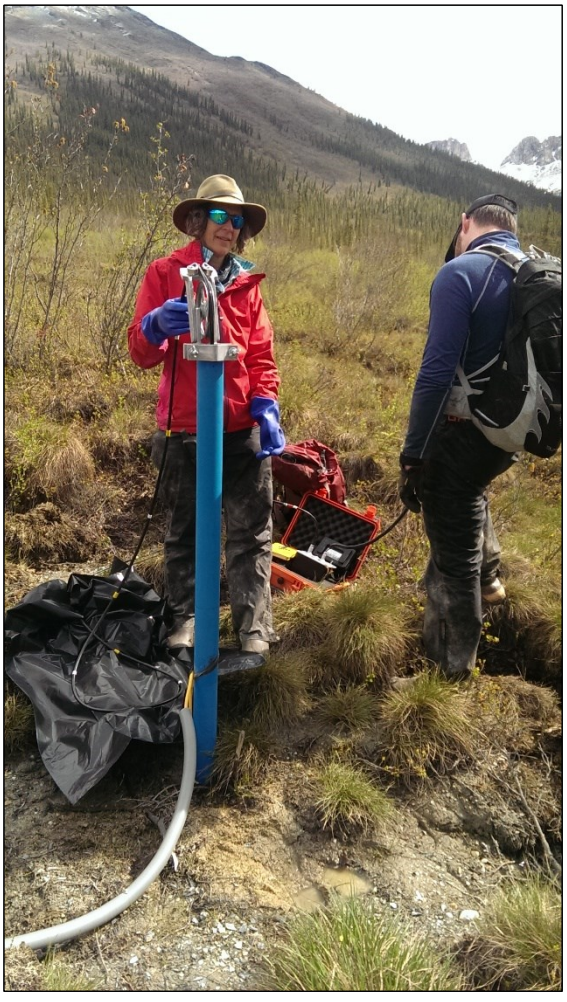
take a fresh look at the amazing world around them. Fantastic images of Helicoprion, the buzz saw shark, a long-neck marine Plesiosaurus, coiled ammonites, and the armored Pachyrhinosaurus combined artistic creation with scientific research. Throughout his fun, student-oriented class, Mr. Troll underscored the importance of learning and hard work to bring his creations to life.

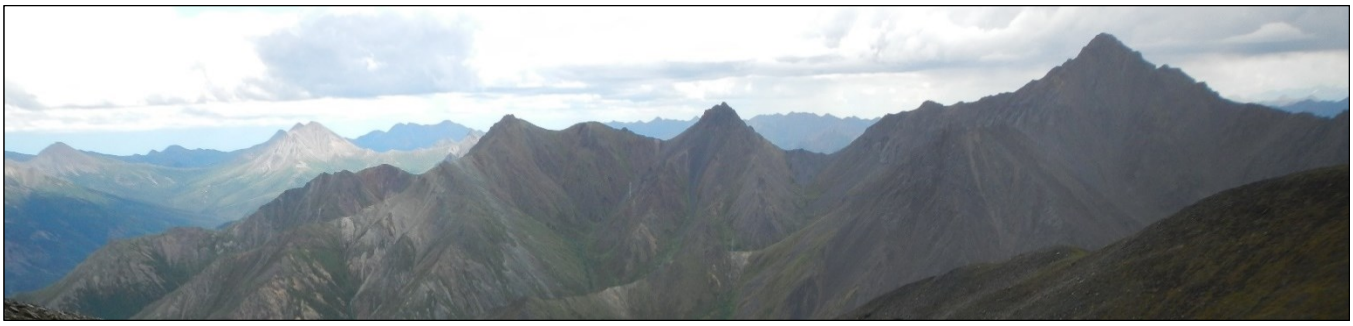
NOTABLE ACHIEVEMENTS

- GMC staff has completed the inventory and shelving backlog resulting from the Eagle River campus relocation and massive numbers of new donations.
- Generated more than $81,000 in surplus sales during the auction of 60 storage containers, two ATCO units, and metal shelving from the former Eagle River repository.
- The Alaska Oil and Gas Conservation Commission (AOGCC) added 233 boxed sample sets of recently drilled energy wells to the GMC collection.
- Two GMC internships provided practical geology experiences for undergraduates in Alaska.
- Volunteer projects tackled the large inventory backlog of foraminifera and palynology slides and curated detached labels on thousands of palynology slides.
- The GMC assisted the DGGS Minerals Section with a "core shack" display at the Alaska Miners Association conference, highlighting field work in the Tok mining district.
- More than 100 people associated with the Association of American State Geologists annual meeting in Girdwood toured the new GMC facility and viewed paleoseismic estuary cores documenting the 1964 Alaska earthquake.

Collection Highlights

3,063	Alaska oil & gas wells
26,500,000	feet of oil & gas strata drilled
16,700,000	representative feet of oil & gas core and cuttings
76,000	linear feet of oil & gas core
2,127	Alaska mineral boreholes
740,000	feet of mineral rock drilled
576,000	representative feet of mineral core and cuttings
332,000	linear feet of mineral core
198,000	processed slides and thin sections
350,000	estimated surface and seismic shot-point samples





MINERAL RESOURCES

Conducts geophysical surveys, geologic mapping, geochemical sampling, and mineral-resource evaluations to determine the potential of Alaskan land for production of metals and minerals.

BENEFIT TO ALASKA

The Mineral Resources Section uses its expertise in geophysics, geology, geochemistry, mapping, and ore deposits to evaluate Alaska's undiscovered mineral potential. Publication of scientific datasets, maps, and mineral-related reports, which are essential to attract industry investment, directly meets DNR's constitutional mandate of promoting responsible development of Alaska's natural resources and the Division's statutory goal of determining the potential for production of metals and minerals on Alaska land.

Evan Twelker, Travis Naibert, Karri Sicard, Alicja Wypych, Abraham Emond, Gina Graham, Melanie Werdon

OVERVIEW

High-grade information: Helping to determine the state's mineral resource potential

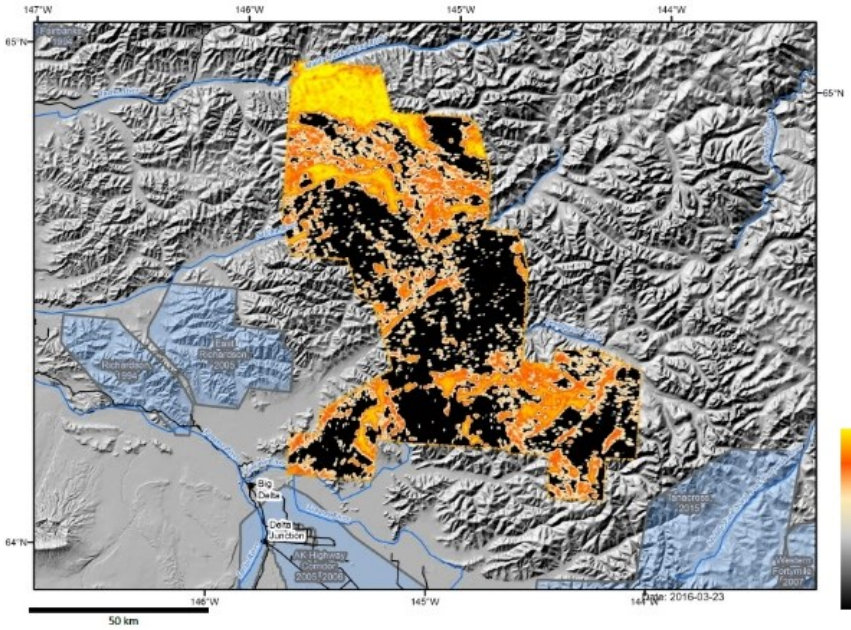
Determining the State's mineral-resource potential involves conducting geophysical surveys, geologic mapping, geochemical sampling, ore deposit research, and tracking mineral industry exploration, development, production, and discoveries. In addition to conducting field investigations and promoting the State's mineral resource potential, the Section's expertise and knowledge are consulted in review of other Departmental actions including: State land selection conveyance prioritization, land-use plans, land disposal actions, review of federal actions, and infrastructure planning.

The geophysical, geological, and resource surveys conducted by the Mineral Resources Section not only inventory the potential of the mineral resources but also add value to the State in terms of current and future revenue. Over the last two decades, the State has conducted airborne geophysical surveys over 13.9 percent of State lands; in 2015, 54 percent of the State mining claim revenue came from the surveyed areas. In per-acre terms, the 2015 mining claim revenue averaged over all state lands was $ 0.02 per acre, whereas the revenue was $ 0.17 per acre in those areas that have been covered by a geophysical survey.

ACCOMPLISHMENTS

DGGS datasets facilitate mineral exploration and discovery: 23 years of the Airborne Geophysical/ Geological Mineral Inventory program

Since 1993 the data products of the DGGS's Airborne Geophysical/Geological Mineral Inventory (AGGMI) program have been important tools to facilitate industry's successful mineral-exploration programs in Alaska. AGGMI products have contributed to private-sector discovery of more than 22 million ounces of gold in the Salcha River–Pogo and Livengood areas since 2004. Freegold Ventures Ltd. used AGGMI magnetic data to target drill holes and stake claims on their Shorty Creek project (2014–2016). Similarly, Endurance Gold used AGGMI magnetic and resistivity data to target drill holes on Elephant Mountain in 2016, and White Rock Minerals Ltd. used AGGMI geophysical data and the DGGS geologic map of the Bonnifield area to stake claims and plan future exploration work. Airborne geophysical datasets are used to assist geologic mapping of an area, particularly in areas with poor bedrock exposure. Mineral companies



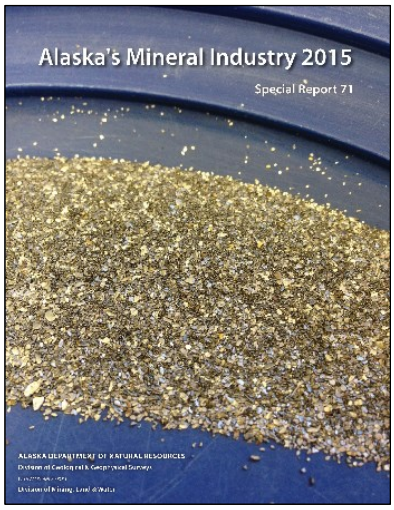
routinely use DGGS airborne geophysical surveys, geologic maps, and geochemical data to guide their more-detailed exploration work, which is necessary to make economic mineral discoveries. Exploration, discovery, and resource development contribute significantly to diversifying and building State's economy, tax revenue, and job creation. The AGGMI datasets also advance the State's knowledge of its mineral resources, and promote informed state, federal, and Native corporation land- and resource-management decisions.

In 2016, DGGS continued upgrading historical airborne-geophysical datasets (for example the Bonnifield survey; doi.org/10.14509/29557) and making them available for digital download. To provide seamless spatial geophysical-data coverage, numerous historical geophysical datasets in the Yukon–Tanana Uplands and eastern Alaska Range were merged and rereleased (doi.org/10.14509/29555). DGGS also solicited bids and awarded a contract to fly a fixed-wing aeromagnetic survey, flown in early 2017, in the Porcupine River area of northeastern Alaska along the border with Yukon Territory. This geophysical survey is being funded by the USGS Minerals Program to support their field investigations of the Porcupine River fault zone and research on the area's mineral-resource potential and tectonic evolution.

Getting the word out: Showcasing Alaska's diverse and substantial mineral potential

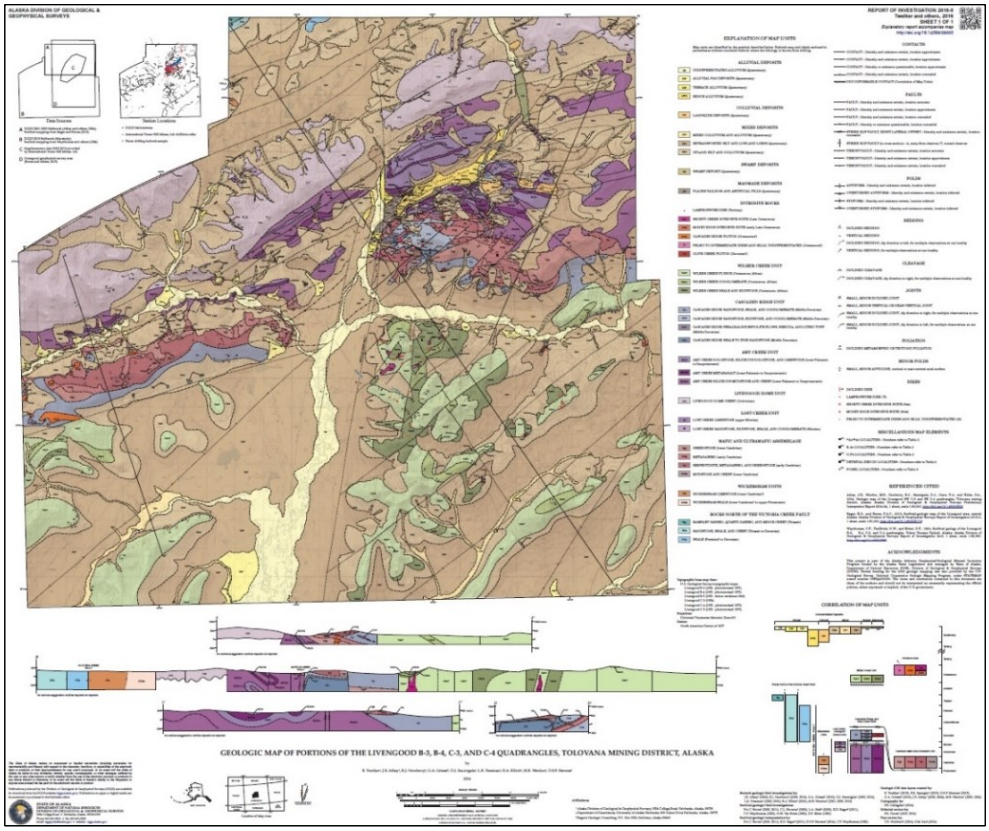
By publishing Special Report 71, *Alaska's Mineral Industry 2015,* and by presenting annual overviews of mineral companies activities in Alaska at national and international mineral-industry conferences, the Division fulfilled DNR's statutory requirement to "...conduct a continuing survey of the mineral resources and mining operations of the state and...disseminate information regarding them..." (AS 27.05.050) and "...make an annual report to the governor on all essential matters with regard to mining in the state" (AS 27.05.060). Special Report 71 is the 36th annual minerals report (dggs.alaska.gov/pubs/minerals). Distribution of more than 580 print copies and 560 downloads of the annual minerals report during 2016 indicate that this is a vital publication.

Alaska is widely recognized as having high mineral-resource potential and a healthy mining economy equivalent to that of many countries, but Alaska is competing to attract international mineral exploration investment with neighboring provinces and other U.S. states that have more developed infrastructure and are perceived as having lower risk. The Alaska Mineral Industry Report and presentations to the mineral industry at mining conferences are the primary vehicle for demonstrating that Alaska has a diversity and quantity of mineral potential and an investment climate competitive with British Columbia, Yukon Territory, Nevada, and Arizona as well as many countries.



Gold and copper discoveries: Livengood geophysical data and geologic maps guide discoveries

Since 1914, approximately 542,000 ounces of gold have been recovered from the historically productive



Livengood placer mining area approximately 80 road miles north of Fairbanks, Alaska. To facilitate lode mineral discovery in this heavily vegetated area, DGGS published an airborne geophysical survey over the Livengood area in 1999, and between 1974 and 2010 DGGS conducted several geologic mapping and geochemical sampling campaigns. These publicly available datasets attracted multiple industry explorers to the area, and eventually were used by International Tower Hill Mines, Ltd. (ITH) to discover the Money Knob intrusion-related gold deposit, with a 22.7-million-ounce measured and indicated gold resource. Similarly, Freegold Ventures Ltd. used DGGS's Livengood airborne geophysical data to target drill holes and stake claims on their Shorty Creek project (2014–2016), and recently announced a 2015 discovery drill hole coincident with an airborne magnetic anomaly that encountered 300 feet of copper–gold–silver mineralization with values equivalent to 0.71 percent copper. In 2016, the DGGS Mineral Resources Section published a 1:50,000-scale comprehensive geologic map of the Livengood area, which synthesizes recently collected and previously published agency data as well as newly donated industry geologic data, to build a better understanding of the geology and mineral-resource potential of the Livengood area.

Strategic and Critical Minerals (SCM) Assessment project

The State of Alaska's Strategic and Critical Minerals (SCM) Assessment project is designed to evaluate Alaska's statewide potential to contribute domestically produced strategic and critical minerals that are required to meet the nation's needs for military and civilian high-tech equipment and electronics, as well as conventional- and green-energy technologies. The objectives of the SCM project are to expand and improve on Alaska's publicly available airborne-geophysical, geological, and geochemical datasets in areas of Alaska with SCM potential, and to use these datasets to demonstrate Alaska's SCM potential to industry. In 2016, DGGS published 582 new, SCM-related geochemical analyses from the Tok River area, and compiled and will publish digital geochemical data for 26,963 historical samples widely distributed throughout Alaska (see figure). DGGS also published nine SCM-related reports. As part of a USGS–DGGS cooperative project, both agencies conducted a statewide GIS- and watershed-based analysis of Alaska to identify areas with SCM potential, created a Geochemical Atlas of Alaska, and coauthored two USGS reports.

NOTABLE ACHIEVEMENTS

- Completed 5 weeks of field-based geologic mapping and rock and stream sediment geochemical sampling, and evaluated the mineral-resource potential of 480 square miles in the Tok River area south of Tok. The Tok River area contains the intrusion-related copper–gold-bearing Noah (Hona) prospect; sulfide and base metal prospects of the "Eagle trend", which may be of volcanogenic or plutonic origin; possible skarns; and steeply dipping, structurally controlled gold-antimony veins. DGGS documented known lode mineral occurrences, discovered 20 new mineral sites, and identified streams with high levels of gold and other mineral-indicator

elements. DGGS published two geochemical reports in FY2017, and ongoing geologic studies and creation of the Tok River geologic map will provide context critical for guiding future mineral exploration in this highly prospective part of the eastern Alaska Range.

- 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.
- Presented 16 talks on Alaska geology and mineral resources at professional meetings.
- Responded to more than 250 public, industry, and agency requests for mineral-resource information.

MINERAL RESOURCES SECTION PUBLICATIONS IN 2016

Alaska's mineral industry 2015, by J.E. Athey, M.B. Werdon, Evan Twelker, and M.W. Henning, 2016, Special Report 71, 45 p. doi.org/10.14509/29687

Alaska's mineral industry 2014, by L.K. Freeman, J.E. Athey, P.S. Lasley, and E.J. Van Oss, 2015, Special Report 70, 60 p. doi.org/10.14509/29515

Geologic map of portions of the Livengood B-3, B-4, C-3, and C-4 quadrangles, Tolovana mining district, Alaska, by Evan Twelker, J.E. Athey, R.J. Newberry, G.A. Griesel, D.J. Szumigala, L.K. Freeman, B.A. Elliott, M.B. Werdon, and D.S.P. Stevens, 2016, Report of Investigation 2016-5, 39 p., 1 sheet, scale 1:63,360. doi.org/10.14509/29665

GIS-based identification of areas that have resource potential for critical minerals in six selected groups of deposit types in Alaska, by S.M. Karl, J.V. Jones, III, and T.S. Hayes, editors, 2016, USGS Open-File Report 2016–1191, 99 p., 5 appendices, 12 plates, scale 1:10,500,000. doi.org/10.3133/ofr20161191

The geochemical atlas of Alaska, 2016, by G.K. Lee, D.B. Yager, J.L. Mauk, Matthew Granitto, P.D. Denning, Bronwen Wang, and M.B. Werdon, 2016, USGS Data Series 908, 25 p., 272 sheets. pubs.er.usgs.gov/publication/ds908

Digital compilation of geochemical data for historical samples from strategic and critical-element occurrences in Alaska: Part I, 2016, by M.J. Blessington, M.B. Werdon, M.S. Seitz, and K.M. Mulliken, in press, Raw Data File. doi.org/10.14509/29473

Reioux, D.A., Werdon, M.B., Seitz, S.S., and Mulliken, K.M., 2016, Digital compilation of geochemical data for historical samples from occurrences of strategic and critical elements in Alaska: Part II—Platinum-group elements (PGE): Raw Data File 2016-12, 2 p. doi.org/10.14509/29474

Preliminary report on mineral occurrences in the Tok River area, Alaska, by Evan Twelker, L.K. Freeman, K.R. Sicard, and A.C. Busk, 2016, Preliminary Interpretive Report 2016-2, 7 p. doi.org/10.14509/29605

Heavy mineral concentration in a marine sediment transport conduit, Bering Strait, Alaska, by J.C. Barker, J.J. Kelley, and A.S. Naidu, 2016, Preliminary Interpretive Report 2016-4, 24 p. doi.org/10.14509/29666

Investigation of rare-earth elements and zirconium in the northern Windy Fork peralkaline pluton, west-central Alaska, by J.C. Barker, 2016, Preliminary Interpretive Report 2016-5, 17 p. doi.org/10.14509/29667

Zircon U-Pb age data, Ray Mountains area, Bettles Quadrangle, Alaska, by A.L. Tuzzolino, P.B. O'Sullivan, L.K. Freeman, and R.J. Newberry, 2016, Raw Data File 2016-7, 19 p. doi.org/10.14509/29662

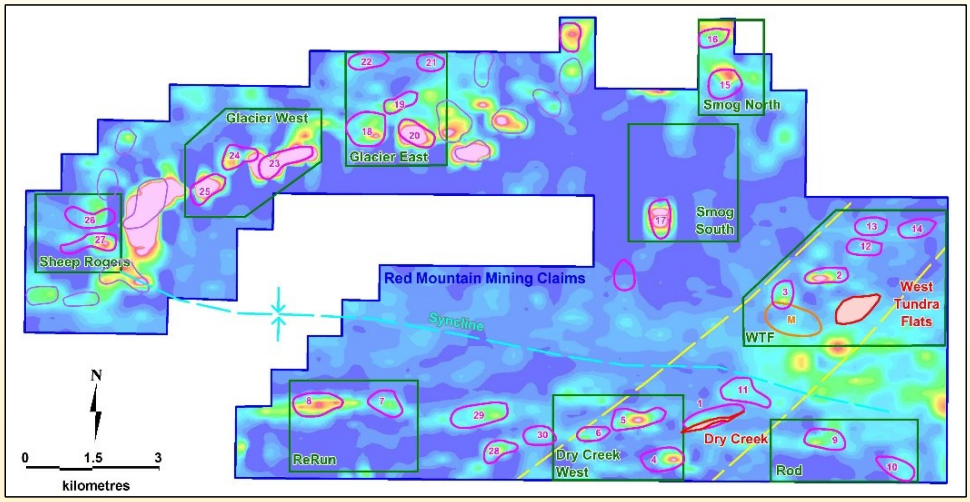
U-Pb zircon age data from meta-igneous rocks in the Clearwater Mountains, Mount Hayes A-6 Quadrangle, Alaska, by Evan Twelker and P.B. O'Sullivan, 2016, Raw Data File 2016-8, 17 p. doi.org/10.14509/29663

Major-oxide and trace-element geochemical data from rocks collected in the Tok River area, Tanacross A-5 and A-6 quadrangles, Alaska, in 2016, by Alicja Wypych, K.R. Sicard, R.J. Gillis, L.L. Lande, T.J. Naibert, R.J. Newberry, Evan Twelker, M.B. Werdon, and A.L. Willingham, 2016, Raw Data File 2016-9, 3 p. doi.org/10.14509/29685

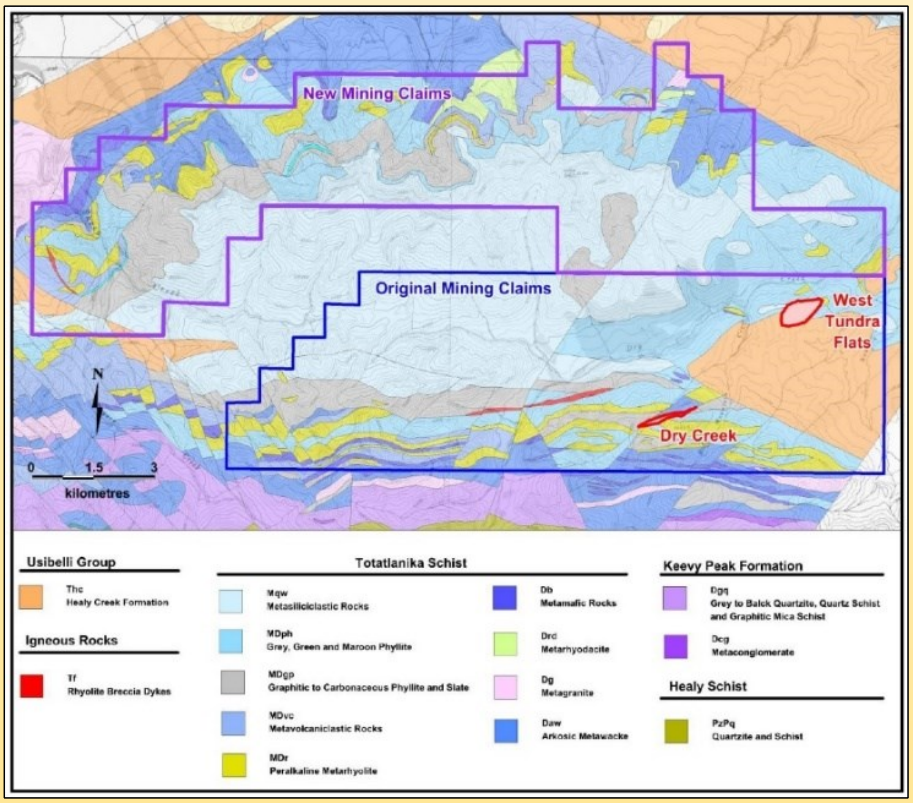
Trace-element geochemical data from stream sediments collected in the Tok River area, Tanacross A-5 and A-6 quadrangles, Alaska, in 2016, by T.J. Naibert, M.B. Werdon, L.L. Lande, and Alicja Wypych, 2016, Raw Data File 2016-10, 3 p. doi.org/10.14509/29688

DGGS DATA GUIDES INDUSTRY CLAIM STAKING AND EXPLORATION TARGETING

In January 2016, DGGS re-released the Bonnifield geophysical survey (dggs.alaska.gov/pubs/gpdata/34) in a revised format that is easier for mineral-exploration geologists to download and use with modern geophysical software. The acquisition of the DGGS geophysical datasets was funded through the State's Airborne Geophysical/Geological Mineral Inventory (AGGMI) program, a long-running initiative to foster economic development and increase State revenues by promoting mineral exploration and discovery. Since initiation of the AGGMI program in 1993, DGGS has collected high-quality magnetic and electromagnetic data covering more than 30,000 square miles of Alaska land with high mineral-resource potential; these geophysical surveys have been one of DGGS's most valuable and sought-after data products. In 2016, White Rock Minerals Ltd. used the DGGS Bonnifield airborne geophysical data to identify future exploration targets (above).



Example of industry use of DGGS geophysical survey. White Rock Minerals Ltd. used historical geochemical data and advanced processing of the DGGS Bonnifield geophysical data to identify target areas for follow-up exploration work. Map from White Rock Minerals Ltd. website, last accessed November 23, 2016. www.whiterockminerals.com.au/projects/red-mountain-project/exploration/



Example of industry use of DGGS geologic map. White Rock Minerals Ltd. used the DGGS preliminary Bonnifield geologic map (doi.org/10.14509/29661) to help locate and stake additional mining claims. Map from White Rock Minerals Ltd., 2016, "White Rock expands its footprint at the highly prospective Red Mountain zinc-silver VMS prospect": White Rock Minerals Ltd. press release dated August 15, 2016, last accessed November 23, 2016. www.whiterockminerals.com.au/investor-centre/asx-announcements/20160815 White Rock expands its footprint at the highly prospective Red Mountain zinc-silver VMS project.pdf

Another important component of the AGGMI program is the creation and publication of geologic maps and reports. In April 2016, DGGS published a preliminary geologic map of the Bonnifield area (dggs.alaska.gov/pubs/id/29661). This map and the DGGS Bonnifield geophysical survey helped White Rock Minerals locate and stake additional claims in the Bonnifield map area (left). DGGS plans to release the final geologic map covering the Bonnifield area in 2017.

Pavlof volcano eruption, March 27, 2016. Photo by Robert Caporn. AVO image id 94361, www.avo.alaska.edu/images/image.php?id=94361

VOLCANOLOGY

Protecting public safety through monitoring and evaluating hazards from Alaska volcanoes and providing timely and accurate warnings of volcanic unrest and eruptions.

BENEFIT TO ALASKA

There are 54 active volcanoes in Alaska and, on average, one or two of these volcanoes erupt each year. Ash in the atmosphere poses a significant threat to commercial air traffic over the North Pacific. More than 50,000 people travel in air routes over Alaska volcanoes every day. As a partner in the interagency Alaska Volcano Observatory (AVO), Volcanology Section staff play a lead role in communicating critical aspects of volcanic unrest and activity, managing the flow of interagency and public information, and conducting geologic studies to improve our understanding of volcanic systems to better forecast future eruptions and assess potential societal impacts.

Katherine Mulliken, Janet Schaefer, Scott Crass, Cheryl Cameron

Geologic Database of Information on Volcanoes in Alaska (GeoDIVA)

Volcanology Section staff design, populate, maintain, and distribute via the web the Geologic Database of Information on Volcanoes of Alaska (GeoDIVA). This data supports scientific investigation, crisis response, and is the heart of AVO's database-driven public website (avo.alaska.edu). GeoDIVA continues to be acknowledged as a worldwide standard of how volcano observatories should store critical information on volcanic activity. It is a robust database, housing large amounts of geological and geochemical data, along with images, a comprehensive bibliography, eruption chronologies, and satellite remote sensing observations. GeoDIVA now contains more than 5,000 bibliographic references on Alaska volcanism. The image database has grown immensely and now

Large pumice clasts from the tephra-fall deposit erupted March 23, 2009, Redoubt Volcano. Information, photographs, and citation information on stations, samples, sample observations and characteristics, as well as chemical whole-rock and glass analysis data is stored, queryable, and served to the public through GeoDIVA. Photo by Kristi Wallace, AVO/USGS. AVO image id 19481, www.avo.alaska.edu/images/image.php?id=19481

contains more than 25,000 searchable images linked to keywords, eruptions, samples, field stations, volcanoes, and more. The on-line, searchable, geochemical database is a massive effort that grows annually with the addition of new data. It now holds more than 9,000 publicly available, whole-rock and glass-geochemical analyses, available at avo.alaska.edu/geochem.

During the past year, the Alaska Tephra Database module of GeoDIVA has seen the most expansion. The database now has an on-line, searchable interface, allowing AVO staff to find and calculate similarity coefficients for more than 2,000 glass analyses from major tephra-producing eruptions in Alaska, significantly streamlining the process of tephrochronologic and ash-fall hazard studies. With the continued expansion and population of GeoDIVA, AVO staff are able to design queries to effectively evaluate relationships between unrest and eruption, making continual progress toward the goal of forecasting eruptions.

Eruption of Pavlof Volcano, March 2016

Pavlof Volcano began erupting abruptly on the afternoon of Sunday, March 27, 2016, sending ash to 20,000 feet above sea level (ASL). AVO alerted the public by releasing a volcanic activity notification, raising the Aviation Color Code to "RED" and the Volcano Alert Level to "WARNING," and a formal call-down was completed to warn other agencies of an impending ash impact. The call-down list includes the FAA air traffic control center, the National Weather Service, Joint Base Elmendorf, NOAA's Volcanic Ash Advisory Center, the U.S. Coast Guard, the Alaska Division of Homeland Security & Emergency Management, the Governor's Office, Eielson Air Force Base, and more. Ash emission continued until midday on March 28, with a maximum ash cloud height of about 35,000 feet. The ash cloud extended more than 400 miles to the northeast of Pavlof, over interior Alaska, resulting in the cancellation of 41 Alaska Airlines flights, affecting 6,200 travelers. Lava fountaining and lightning were observed from Cold Bay. Minor ashfall occurred at Nelson Lagoon on the evening of March 27 and morning of March 28, while trace ashfall was reported at Dillingham, Port Heiden, and Togiak on March 28.

Pavlof volcano in eruption, March 28, 2016. Photo by Nahshon Almandmoss, U.S. Coast Guard. AVO image id 93551, www.avo.alaska.edu/images/image.php?id=93551

During volcanic unrest and eruption, DGGS Volcanology staff stop all project work and immediately focus on the needs of the affected communities. All formal communication regarding Color Code changes and volcanic activity updates are run through servers operated and maintained by DGGS staff. AVO Facebook (facebook.com/alaska.avo) and Twitter (@alaska_avo) accounts are monitored to collect and document observations made by local residents, and to respond to questions from the public. DGGS Volcanology staff administer, populate, and maintain all content on the AVO public website—the authoritative source for all information regarding the eruption, such as ashfall and drifting ash cloud forecasts, seismic instrument data, webcam images, photographs, and formal volcanic activity notifications. In addition to managing these communication pathways, Volcanology Section staff help to cover the 24-hour seismic and satellite data-monitoring shifts that are necessary to provide proper warning of heightened activity or impending eruption.

Geologic mapping and volcano hazard assessment: Chiginagak, Kasatochi, Makushin, and Okmok volcanoes

Understanding the geologic history of volcanoes is one of the most important tools in volcano hazard and risk assessment. Without knowledge of a volcano's eruption history, including the frequency, magnitude, and style of past eruptions, it is difficult to constrain future eruptive capability. Volcanology section staff, along with colleagues from both USGS and the University of Alaska Fairbanks (UAF), are advancing the understanding of volcanic processes and hazards with geologic mapping, geochemical, and tephra studies at Chiginagak, Kasatochi, Makushin, and Okmok volcanoes. The Chiginagak and Kasatochi geologic investigations are well into the publication process—

geologic information for both volcanoes has been compiled into the National Cooperative Geologic Mapping Program GIS data format in preparation for release as a geologic map, geologic report, and geospatial database. Data files include mapped units, whole-rock geochemistry, and $^{40}Ar/^{39}Ar$ geochronology. At Makushin volcano, a stratigraphic framework of Holocene ash fall has been completed, including geochronology and glass chemistry analyses. Field investigations helped determine that Dutch Harbor has been impacted by multiple ash fall events. Understanding the frequency and magnitude of these ashfall events is critical in ashfall hazard risk assessment of the region. Okmok volcano erupts frequently and, in 2008, the eruption forced the evacuation of a family and ranchers living on the island. Our current geologic studies document post-2008 eruption landform changes, describe the stratigraphy and preservation characteristics of the 2008 ash fall, and expand our knowledge of the timing and extent of the various phases of the ~2,050 yr B.P. caldera-forming eruption.

AVO geologist Jessica Larsen (UAF/GI) examining a vertical stream cut section that exposes a rhyodacite fall (yellow), a coarse andesite fall (head level), and massive pyroclastic flow deposited during the ~2,050 yr B.P. Okmok caldera-forming eruption. Photo by Janet Schaefer, DGGS. AVO image id 98321, www.avo.alaska.edu/images/image.php?id=98321

NOTABLE ACHIEVEMENTS

- Helicopter procurement and fuel logistics support for all AVO field projects including geophysical monitoring station maintenance, geologic field investigations, and eruption response.
- As part of the Alaska Tephra Database project, reviewed more than 600 published and unpublished resources with the potential to contain tephra information including peer-reviewed journal articles, theses/dissertations, and reports. Uploaded more than 2,600 tephra samples and over 1,700 tephra glass geochemical analyses.
- Created an interface to calculate similarity coefficients in the tephra database, giving users the ability to create user-defined glass chemistry datasets by querying the data, then calculating a similarity coefficient between datasets.
- Integrated the new version of the U.S. Volcano Hazards Program, Hazard Alert Notification System (HANS), to enable functionality within AVO's database structure. When new volcano alerts are distributed, our interconnected database fields are automatically populated with the hazard alert and Color Code information needed to keep our website and internal web tools up-to-date and functional.
- Analyzed AVO's volcanic activity notifications and alerts through time, eruption, and unrest periods to determine AVO's alert effectiveness and improve the quality and timeliness of messages. Results were presented in a talk and poster at the international conference "Cities on Volcanoes 9" in November 2016.
- Authored AVO's 2014 annual summary of volcanic activity (currently in USGS editorial review) and coauthored the 2015 annual summary. A summary of Alaska's volcanic activity has been published annually since 1993 and DGGS Volcanology staff member C. Cameron is now taking the lead author role, previously assigned to USGS/AVO staff.

VOLCANOLOGY SECTION PUBLICATIONS IN 2016

Geologic map of the Valdez D-1 and D-2 quadrangles (Mount Wrangell Volcano), Alaska, by D.H. Richter, R.G. McGimsey, K.A. Labay, M.A. Lanphere, R.B. Moore, C.J. Nye, D.S. Rosenkrans, and G.R. Winkler, 2016, USGS Scientific Investigations Map 3351, 20 p., scale 1:63,360. ***doi.org/10.3133/sim3351***

Water-magma interaction and plume processes in the 2008 Okmok eruption, Alaska, by J.A. Unema, M.H. Ort, J.F. Larsen, C.A. Neal, and J.R. Schaefer, 2016, GSA Bulletin, 15 p. doi.org/10.1130/B31360.1

Alaska Volcano Observatory image database, by C.E. Cameron and S.F. Snedigar, editors, 2016, Digital Data Series 13. www.avo.alaska.edu/images/

Pavlof volcano eruption, March 28, 2016. Photo by U.S. Coast Guard Petty Officer Austin Torres. AVO image id 93751, www.avo.alaska.edu/images/image.php?id=93751

RELATIONSHIPS WITH OTHER AGENCIES

DGGS develops its strategic programs and project schedule through consultation with the many users of geologic information—State and Federal agencies, the Alaska 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.

STATE AGENCIES

DGGS provides other DNR and state 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; oil and gas and mineral potential; and construction materials availability.

Each year DGGS works closely with:

- DNR 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
- DNR Office of Project Management and Permitting, with technical expertise during large project permitting
- Division of Economic Development in the Department of Commerce, Community, and Economic Development (DCCED), to report on the status of Alaska's mineral industry
- Division of Homeland Security & Emergency Management (DHSEM; in the Department of Military and Veterans Affairs [DMVA]), and the Department of Environmental Conservation (DEC) to evaluate volcanic and other hazards, develop scenarios for hazards events, and update the State Hazard Mitigation Plan
- Department of Transportation & Public Facilities (DOT&PF), University of Alaska Fairbanks (UAF), and other agencies to assess the impacts of landslides, slope failures, avalanches, flooding, erosion, and construction materials availability
- Alaska Energy Authority (AEA) to evaluate hazards to proposed hydroelectric, geothermal, and other energy projects
- DNR Division of Mining, Land and Water (DMLW) to evaluate groundwater issues and address land selection and sale questions
- Alaska Energy Authority to provide technical expertise on geothermal resource potential; DGGS also evaluates resource potential around the state that might provide viable alternatives for energy development in rural Alaska
- In recent years with the Alaska Natural Gas Pipeline project, Alaska Gasline Development Corporation (AGDC), and the State Pipeline Coordinator's Office (SPCO) to assist in geologic data collection and hazards risk assessment for proposed natural gas pipelines

Large inter-division or other one-time efforts responding to special needs are generally supported by interagency fund transfers. Smaller requests are funded by DGGS's annual general fund appropriation.

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 communities for which inundation maps have been prepared in recent years, DGGS works closely with collaborators and city and borough governments to design project outputs to meet community needs for planning evacuation areas and routes.

DGGS works closely with local communities to help assess hazards and alternatives for mitigating the effects of erosion, flooding, and other surface processes that threaten their sustainability. DGGS also sends personnel to respond to natural disasters, such as the Sitka landslides in September 2015. Similarly, DGGS works with rural communities to help assess potential local energy resources as alternatives to diesel fuel. During volcanic unrest and eruption, DGGS, as a partner in the Alaska Volcano Observatory, communicates with local villages, industry sectors, and the military to share information and observations of volcanic unrest.

THE UNIVERSITY OF ALASKA

DGGS has a longstanding and productive professional association with geoscientists and students at the University of Alaska. University of Alaska faculty work as project team members on a wide range of collaborative research projects. University student interns also are an important part of the DGGS workforce; while working on DGGS projects, students learn a wide variety of geology-related skills. 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. University of Alaska faculty and students frequent the Geologic Materials Center in Anchorage, where faculty conduct core logging classes. DGGS's Volcanology Section has a long-term cooperative relationship with the UAF Geophysical Institute resulting from partnership in the Alaska Volcano Observatory.

FEDERAL AGENCIES

DGGS has cooperative programs with numerous Federal agencies including the U.S. Geological Survey (USGS), National Oceanic and Atmospheric Administration (NOAA), U.S. Fish and Wildlife Service (FWS), and periodically with Federal Emergency Management Agency (FEMA), U.S. Department of Housing and Urban Development (HUD), the U.S. Bureau of Land Management (BLM), and the U.S. Department of Energy (DOE). 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), National Aeronautics and Space Administration (NASA), and the National Science Foundation (NSF).

DGGS receives 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, geologic-hazards evaluations, and studies related to oil and gas and geothermal potential. Although DGGS has historically been very successful in being awarded Federal grants and appropriations, the process is 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 advance and serve the Division's statutory mission.

Two ongoing cooperative Federal programs 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 consisting of USGS, DGGS, and the University of Alaska Fairbanks Geophysical Institute (UAFGI). The USGS funds and administers the program for the purpose of providing a coordinated approach to mitigating volcano-hazard risks to the public, state infrastructure, and air commerce. The second ongoing program is the STATEMAP component of the National Cooperative Geologic Mapping Program, established by Congress in 1992 and administered by the USGS. STATEMAP provides matching funds for geologic mapping projects according to priorities set by the Alaska Geologic Mapping Advisory Board (GMAB; see below).

DGGS has been successful in receiving cooperative agreements for two key federal programs, the National Geological & Geophysical Data Preservation Program (NGGDPP) and the National Cooperative Geologic Mapping Program (NCGMP). The NGGDPP, funded by the USGS, has supported several DGGS projects to preserve and make geologic information publicly available. NCGMP funds provide a stable source of federal funding for geologic mapping in the state.

ALASKA GEOLOGIC MAPPING ADVISORY BOARD

The Alaska Geologic Mapping Advisory Board (GMAB) 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 multi-fold. The board held its first meeting in Fairbanks on October 22, 1995, and normally meets three times a year to discuss state needs, review DGGS programs, and provide recommendations to the State Geologist. Members solicit and welcome comments and suggestions from the public concerning state needs and DGGS programs throughout the year.

Current members of the board are:

STEVE ADAMCZAK

Vice President, Shannon and Wilson, Inc.

Mr. Adamczak has more than 30 years of experience in geotechnical engineering, and represents the engineering geology and geotechnical community.

MARGARET DARROW

Chair of the University of Alaska Fairbanks Department of Mining and Geological Engineering

Dr. Darrow has a background in engineering geology with, and represents, the University, the Department and also the engineering geology discipline.

CURT FREEMAN, CHAIR

President, Avalon Development Corporation

Mr. Freeman runs a well-known and successful consulting mineral exploration firm in Fairbanks and represents minerals industry interests.

TOM HOMZA

Principal Regional Geologist, Shell Exploration and Production, Alaska

Dr. Homza has 18 years oil and gas exploration experience and represents petroleum industry interests.

JAMES JONES

U.S. Geological Survey

Dr. Jones specializes in tectonic evolution and mineral resources with the USGS Anchorage office, and represents the Federal government, earthquake hazards, and mapping interests.

ANUPMA PRAKASH

Co-Chair of the University of Alaska Fairbanks Department of Geology and Geophysics

Dr. Prakash has a background in remote sensing in the Arctic, this along with her University affiliation will complement the talents and experience of the other board members.

GREGORY WILSON

Director Arctic Exploration and Services, ConocoPhillips Alaska

Dr. Wilson has more than 25 years of oil and gas exploration experience in Alaska and also represents the oil and gas industry.

THANK YOU, LANCE MILLER!

This year DGGS and the Board said farewell to Dr. Lance Miller, of NANA Corporation. Lance served on the board since 1999, and during that time DGGS benefited greatly from his well-reasoned and sound advice. We wish to heartily thank you, Lance, for your service to this organization, and by extension, the state. We are sorry to lose you to the increasing demands of your day job, but wish you well in your future endeavors and look forward to continuing the long and close relationship between our organizations.

WHY DO WE EXIST?

MISSION STATEMENTS

Department of Natural Resources: Develop, conserve, and enhance natural resources for present and future Alaskans

Division of Geological & Geophysical Surveys: 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 41.08.

- Territorial Department of Mines, prior to 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

Eleven qualified professional geoscientists have served as State Geologist:

- Jim Williams, 1959–1971
- William Fackler, 1971–1973
- Donald Hartman, 1973–1975
- Ross G. Schaff, 1975–1986
- Robert B. Forbes, 1987–1990
- Thomas E. Smith, 1991–1995
- Milton A. Wiltse, 1995–2002
- Rodney A. Combellick (Acting), 2003–January 2005
- Mark D. Myers, February–October 2005
- Robert F. Swenson, November 2005–November 2013
- Steven S. Masterman, November 2013–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, State Geologists have been selected from lists of candidates prepared by the geologic community and professional societies in 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.

Linda Natrop, State Geologist Steve Masterman, Shelly Showalter, Ken Papp, April Woolery

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 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. (1 ch 93 SLA 1972)

Sec. 41.08.045. Fees for facilities, equipment, products and services. The division of geological and geophysical services may charge and collect a fee for facilities, equipment, products or services that the division offers.

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. The division is led by Director and State Geologist Steve Masterman.

ORGANIZATION

DGGS is one of seven divisions and seven 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 39 permanent full-time professional and support positions, 1 permanent part-time position, with additional nonpermanent staff, and student interns.

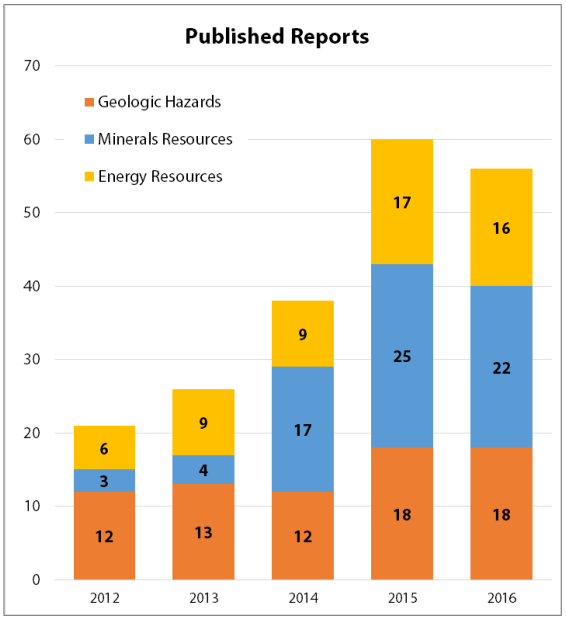
Division of Geological & Geophysical Surveys main office, 3354 College Road, Fairbanks

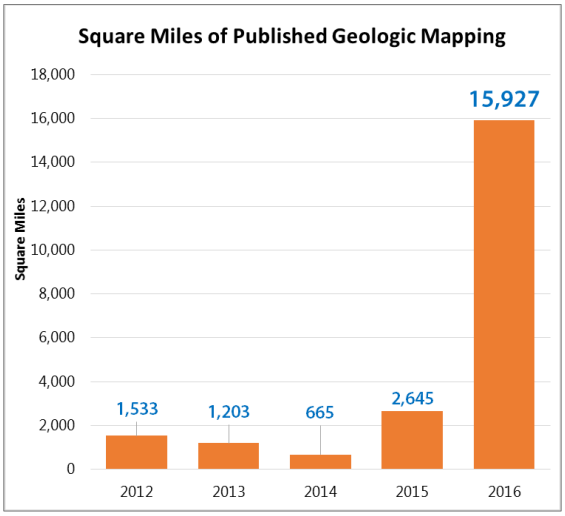
Alaska Geologic Materials Center, 3651 Penland Parkway, Anchorage

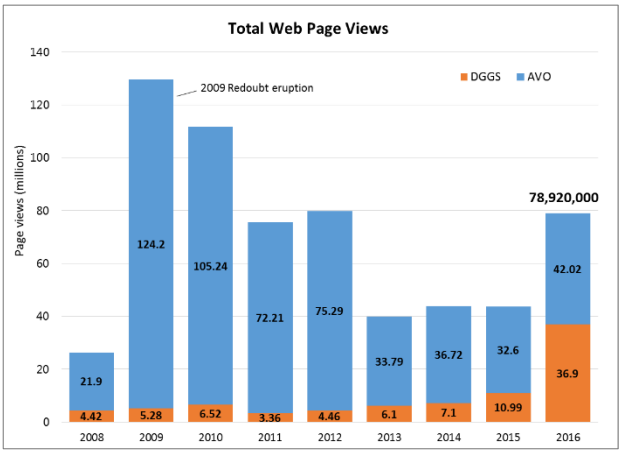
PERFORMANCE MEASURES

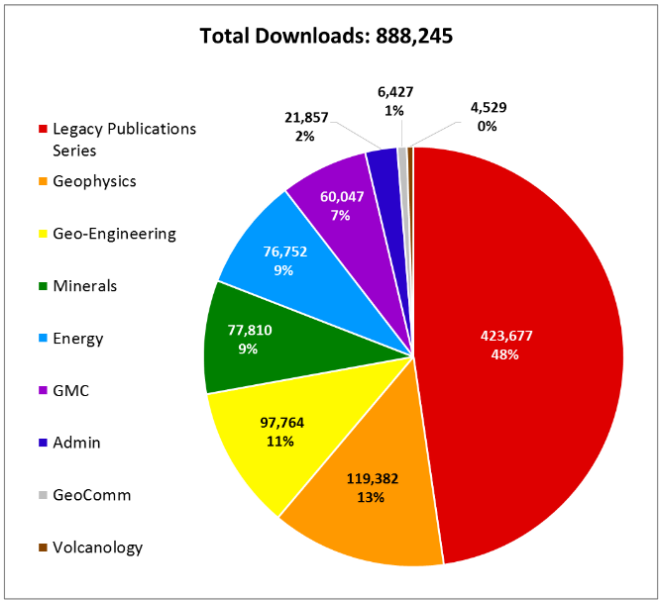
TOP 10 MOST VISITED DGGS WEBSITES

Rank	Page	URL
1	Elevation Datasets in Alaska	maps.dggs.alaska.gov/elevation
2	DGGS homepage	dggs.alaska.gov
3	Quaternary Faults and Folds (QFF)	maps.dggs.alaska.gov/qff
4	Alaska Shoreline Change Tool	maps.dggs.alaska.gov/shoreline
5	USGS Alaska IfSAR Status Map, 1° cells	maps.dggs.alaska.gov/ifsarstatus
6	Directory Listing of Downloadable IfSAR Data	dggs.alaska.gov/elevation/dds4/ifsar
7	Interactive Maps homepage	maps.dggs.alaska.gov
8	DGGS Publications Search	dggs.alaska.gov/publications
9	Geologic Materials Center (GMC)	maps.dggs.alaska.gov/gmc
10	USGS Dictionary of Alaska Place Names (Professional Paper 567)	dggs.alaska.gov/webpubs/usgs//text/p0567.pdf

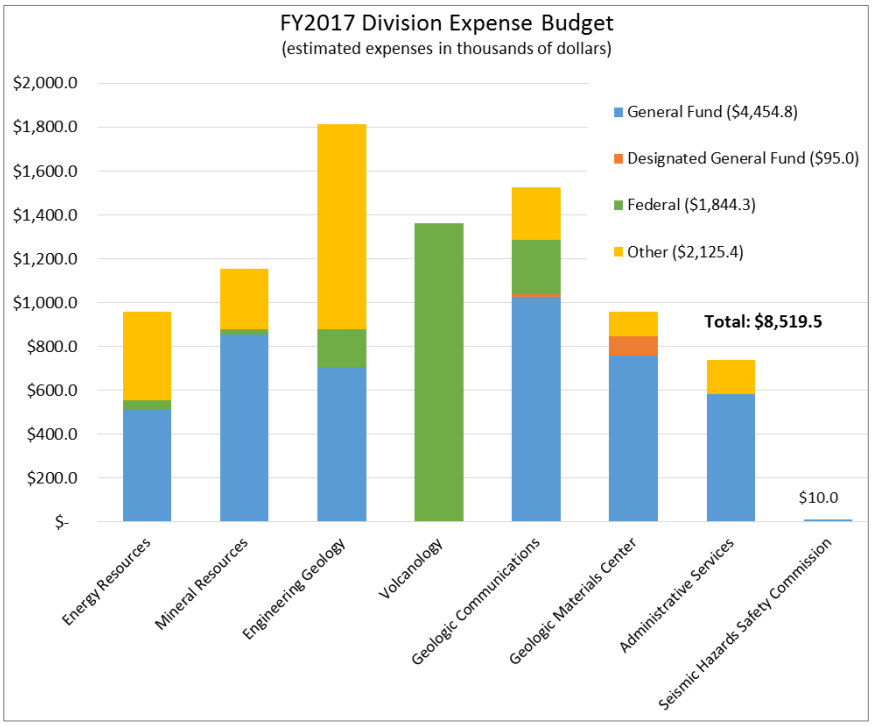








FINANCES


FY2017 Division Expense Budget
(estimated expenses in thousands of dollars)
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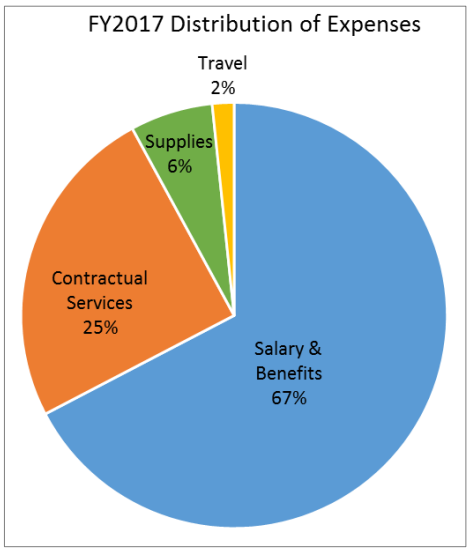
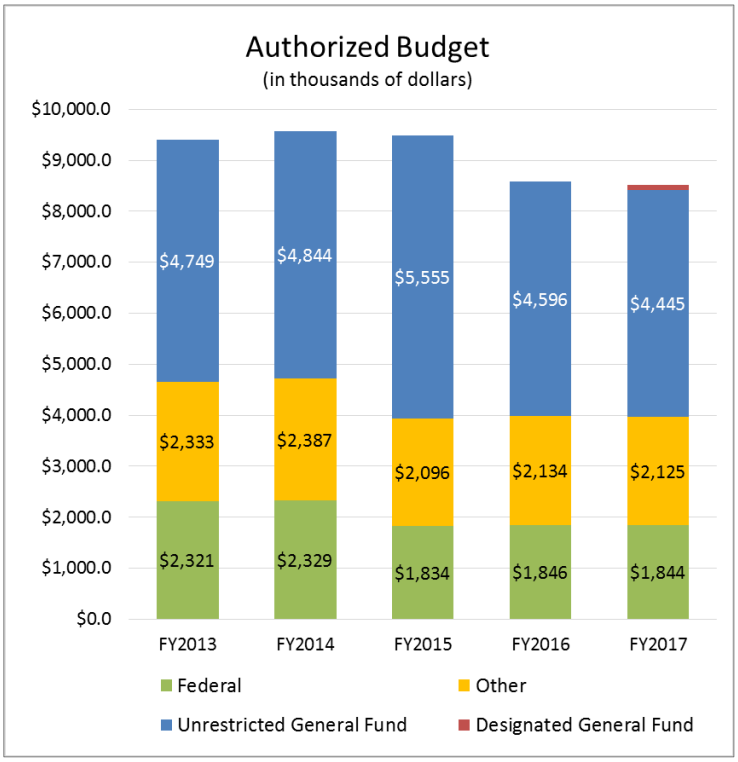
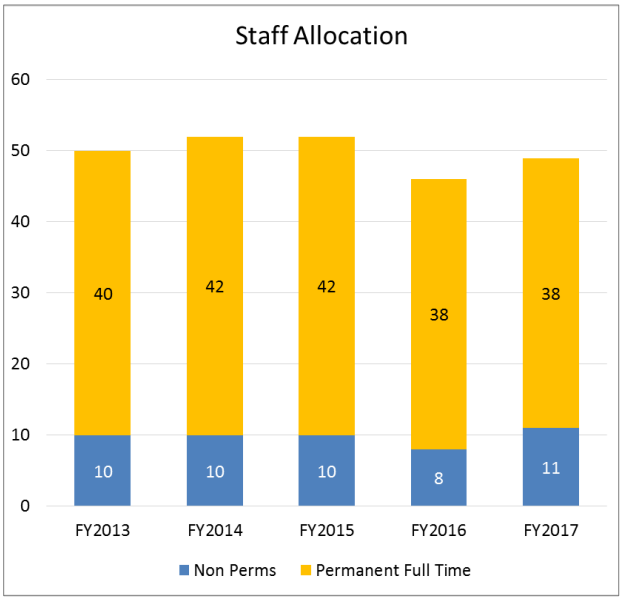
$1,800.0
$1,600.0
$1,400.0
$1,200.0
$1,000.0
$800.0
$600.0
$400.0
$200.0
$-
General Fund ($4,454.8)
Designated General Fund ($95.0)
Federal ($1,844.3)
Other ($2,125.4)
Total: $8,519.5
$10.0
Energy Resources
Mineral Resources
Engineering Geology
Volcanology
Geologic Communications
Geologic Materials Center
Administrative Services
Seismic Hazards Safety Commission


FY2017 Distribution of Expenses
Travel
2%
Supplies
6%
Contractual
Services
25%
Salary &
Benefits
67%


Authorized Budget
(in thousands of dollars)
$10,000.0
$9,000.0
$8,000.0
$7,000.0
$6,000.0
$5,000.0
$4,000.0
$3,000.0
$2,000.0
$1,000.0
$0.0
$4,749
$4,844
$5,555
$4,596
$4,445
$2,333
$2,387
$2,096
$2,134
$2,125
$2,321
$2,329
$1,834
$1,846
$1,844
FY2013
FY2014
FY2015
FY2016
FY2017
Federal
Other
Unrestricted General Fund
Designated General Fund

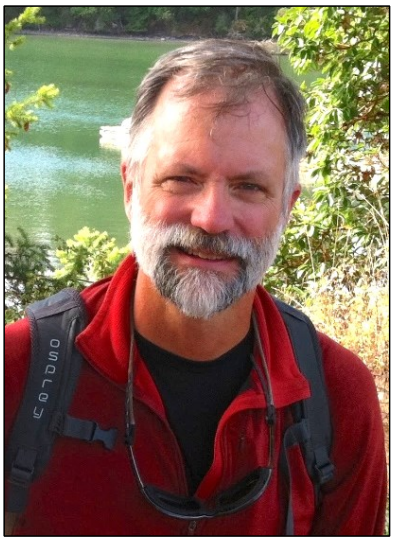

Staff Allocation
60
50
40
30
20
10
0
40
42
42
38
38
10
10
10
8
11
FY2013
FY2014
FY2015
FY2016
FY2017
Non Perms
Permanent Full Time

EMPLOYEE TRANSITIONS

BON VOYAGE—HAPPY SAILING!

Lawrence (Larry) Freeman

Larry retired from DGGS at the end of June 2016, to explore the coast of Alaska, British Columbia, and Washington with his wife, Elizabeth, on their sailboat, Toolik.



Larry joined DGGS in 2000 after working in the minerals industry for 23 years. He started as the manager of the database project to design and build a modern system to manage and store DGGS data and publications and to deliver that data to the public. In 2007 Larry transitioned from the database project to geologic mapping in the Mineral Resources Section, participating in a number of mapping projects. In late 2013 he became the Mineral Resources Section Chief and coauthored three Alaska Mineral Industry Reports. Larry is sad to leave his co-workers, especially those with whom he collaborated in geologic research and to build DGGS data system; he also misses providing data and advice in the management and wise development of Alaska's mineral resources. However, after spending most of the previous 32 summers apart, Larry and Elizabeth are looking forward to exploring the Alaska and Pacific Northwest waters and coastal outcrops together.

GOING, GOING, GONE!!

Joni Robinson

Joni retired in May 2016 after working untiringly for DGGS for more than 28 years, beginning in 1988. During her tenure she capably filled the positions of Secretary to the Director, Administrative Assistant, Publications Technician, and Publications Specialist. The main focus of the Specialist position was preparing the scientific reports for publication. In addition to designing and creating layouts for publications in an incredibly short amount of time, Joni also skillfully tracked the steps of hundreds of concurrent reports in progress—from submission through completion. She successfully worked with authors, section chiefs, report reviewers, and editor to ensure all of the reports had gone through all of the necessary steps and ensured each step was carefully documented. She also knew all of the elements required for each report type and made sure all were included.

Joni is missed for her conscientiousness and dedication to her job and the division, for her exemplary organizational skills, and for her work behind the scenes to make sure everything got done right *and* on time; however, we miss her sense of humor and her friendship most of all. Joni showed genuine care and compassion to others and was appreciated by all of those with whom she interacted, inspiring us with her quiet leadership.

Joni spends her spare time knitting, quilting, and volunteering. Now that she is retired she plans to do a lot of hiking, biking, traveling, and possibly learning to golf. She looks forward to spending her retirement in Arizona where she won't have to plug in her car anymore—although the little warm-weather creatures there are cause for concern.

BRINGING IN THE NEW…

Amanda (Mandy) Willingham

Mandy came to DGGS from DNR's Division of Mining, Land & Water (DMLW), where she adjudicated state land leases and material sales, as well as assisted with management of contaminated sites.

Prior to her work at DMLW, she worked in the Alaska mineral exploration industry sampling, mapping, and core logging. Mandy obtained her master's degree in Geological Sciences from University of California Santa Barbara, where she investigated the uplift timing of a mid-crustal dome that cross-cut regional scale faults in the Tibetan Himalaya using U-Th-Pb geochronology in conjunction with field mapping to constrain timing of a shift from contractional to extensional tectonic regimes. She will be applying her field mapping, geochronology, and structural geology expertise to energy-resource-related topics in her work here at DGGS.

COMING AND GOING, ALL IN <1 YEAR!

Kara Lewandowski

Kara joined us in July 2016 to fill the Publications Specialist position vacated by Joni Robinson in May. She had experience with public relations work and was already an experienced InDesign user, so that made a tough transition a little easier. We were fortunate that Joni was still in Alaska and was able to show Kara the ropes. Kara was a hard worker with a good sense of humor (a necessity when dealing with complex layouts) and had made great progress.

Kara shared her very positive, happy outlook with DGGS co-workers after several years of work in Alaska as a park ranger, most recently at Lake Clark National Park and Preserve. She has a strong affinity for the outdoors and breathing the fresh air, and made good use of her weekends in Fairbanks, with quite a few exciting adventures. Needless to say, she fit in well with our staff. Unfortunately, she was lured away by a "dream" Park Service job she couldn't pass up, and her last day with DGGS was December 30. She is now happily employed with NPS at Lake Clark National Park as its PR person—flying around taking pictures and "selling" the park as an ecotourism destination.

We wish Kara well in her new job in Alaska, along with many hours of safely working with the friendly bears (and likely tourists) that she will encounter.

DGGS STAFF

firstname.lastname@alaska.gov

State Geologist's Office

Steve Masterman
State Geologist/Director

Kenneth Papp
Division Operations Manager

Administration

Shelly Showalter
Administrative Officer II/Section Chief

April Woolery
Administrative Assistant III

Linda Natrop
Natural Resources Tech II

Energy Resources

David LePain
Petroleum Geologist I/Section Chief

Robert Gillis
Geologist IV

Nina Harun
Geologist II

Trystan Herriott
Geologist III

Marwan Wartes
Geologist IV

Amanda Willingham
Geologist II

Engineering Geology

De Anne Stevens
Geologist V/Section Chief

Ronald Daanen
Geologist IV

Trent Hubbard
Geologist IV

Jacquelyn Overbeck
Geologist IV

Barrett Salisbury
Geologist IV

Gabriel Wolken
Geologist IV

Geologic Communications

Paula Davis
Publications Specialist III/Section Chief

Jennifer Athey
Geologist IV

Patricia Gallagher
GIS Analyst III

Michael Hendricks
GIS Analyst III

Bobby Kirchner
Microcomputer/Network Tech I

Kara Lewandowski
Publications Specialist I

Simone Montayne
Geologist III

Linda Natrop
Natural Resource Tech II

Chris Ramey
Analyst/Programmer IV

Susan Seitz
Analyst/Programmer IV

Ken Woods
Micro/Network Specialist II

Geologic Materials Center

Kurt Johnson
Geologist V/GMC Curator

Jean Riordan
Geologist III

Mineral Resources

Melanie Werdon
Geologist V/Section Chief

Abraham Emond
Geologist IV

Gina Graham
Geologist III

Karri Sicard
Geologist III

Evan Twelker
Geologist IV

Alicja Wypych
Geologist III

Volcanology

Janet Schaefer
Geologist V/Section Chief

Cheryl Cameron
Geologist IV

Scott Crass
Analyst/Programmer IV