Alaska Division of Geological & Geophysical Surveys
ANNUAL REPORT 2015

State of Alaska
Department of Natural Resources
Division of Geological & Geophysical Surveys
January 2016

STATE OF ALASKA

Bill Walker, *Governor*

DEPARTMENT OF NATURAL RESOURCES

Mark D. Myers, Ph.D., *Commissioner*

DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

Steve Masterman, *State Geologist and Director*

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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)

Publication of this report is required by Alaska Statute 41.08

FROM THE DIRECTOR...

2015 was a banner year for the Division. From providing information related to oil and mineral discoveries to helping after fatal landslides, DGGS staff continue their dedicated efforts to stimulate our economy, and protect our residents. This annual report is a brief summary of the many achievements of the energetic, resourceful, and committed staff here at DGGS. I hope you can make time to read it, and learn more about the great work done by the state's geological survey.

Investing in geologic information is necessary for the discovery and commercialization of the state's undiscovered oil, gas, coal, and mineral 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. As this report shows, DGGS collects, analyzes, and publishes the geologic information vital to attracting investors to Alaska, in the discovery of petroleum and mineral resources, and in building safe and stable communities.

During the past year DGGS learned of a significant oil discovery on 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. In November, industry announced a significant gold–copper discovery from a mineral exploration drilling program that used the State-funded airborne geophysical data in their drill targeting. These two significant discoveries demonstrate that not only is DGGS using its State funding to produce the right information in the right locations, but industry is acquiring and using DGGS products, and as a result is having exploration success. DGGS is understandably proud of the role the State-funded work played in these new discoveries.

DGGS geologists responded rapidly to aid the recovery efforts in Sitka following the fatal landslides in September 2015. The community and emergency responders were grateful to have the State's geologic hazard experts rendering assistance. We at DGGS are thankful for the opportunity to help our fellow Alaskans, and stand ready to assist other communities should they experience natural disasters.

DGGS coastal inundation maps were enthusiastically endorsed by the communities impacted by, thankfully, moderate flood events this fall in western Alaska. Another product that has been well received is the digital Shoreline Change Tool that allows communities to evaluate how their coastline has changed, and will continue to change, over time. 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.

The product that brought DGGS into more offices and homes during the last year is our Elevation Datasets in Alaska web page. This page provides publicly available digital topographic data for the state, and is updated whenever more data becomes available. DGGS staff created this unique interface allowing anyone to access, view, and download 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.

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 spring the archive, representing over 15 million feet of drilling, was moved from the old, dilapidated, and leaky facility in Eagle River, to a newly refurbished facility in Anchorage. The new building was opened in July and, while more expensive to maintain and operate than the prior location, it will preserve, grow, and provide access to geologic materials for decades to come. Any one box in the collection may hold the sample that leads to a major new discovery. Moving the collection and opening the facility was a milestone, capping years of effort and commitment on the part of the State.

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 activities, products, and impacts.

Respectfully,

Steven S. Masterman

S. Masterman

State Geologist & Director

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Trystan M. Herriott

Alaska Division of Geological & Geophysical Surveys
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KEY ISSUES

DGGS faces numerous critical issues, and has to 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.

Oil and Gas Development

Alaska's North Slope and Cook Inlet are both mature hydrocarbon basins. Like all mature hydrocarbon basins, the 'easy' prospects were drilled and tested early, with the untested, remaining plays requiring significant geologic research and investment to reach discovery and production. New geologic information is the key to resource discovery. DGGS will continue to be challenged to provide 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 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 its competing markets is increasingly important because of fierce global competition for exploration expenditures. Alaska ranks very high in terms of mineral potential, but in terms of the quality of its geologic datasets, its current mid-tier rank is threatened. 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.

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 quick 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 key 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 thaw settlement from melting permafrost, erosion, storm surges, landslides, sea-level change, and changes in the hydrologic system. 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, or 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 will undoubtedly increase maintenance requirements on Alaska's buildings, rail, highway, and airport systems. Identifying geologic hazards and areas prone to 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 Artic impacts become more broadly appreciated. DGGS geoscientists play a leading role in guiding 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 geological survey, DGGS will be challenged to guide research to provide the necessary data on 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. DGGS's ability to not only guide, but also provide reliable, unbiased data for the development and evaluation of emerging policy and statute changes will be challenged. 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 developing and applying 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 geological materials was moved from its former location in Eagle River to the newly remodeled facility on Penland Parkway in Anchorage in spring 2015. This collection 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 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 is proposing to institute 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.

FY2016–2017 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 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 the state's vast and diverse unconventional energy resources.
- Release new geology map from recent field mapping program in the Tyonek area in Cook Inlet.
- Provide new information on the liquid petroleum potential of Alaska's coal.

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 Livengood map areas are priorities.
- Continue release of new, reanalyzed, and redigitized geochemical data to support the Strategic and Critical Minerals project.
- Begin making digital field-station mapping data available via the website.
- Safely complete a geologic mapping project in the Tok area.

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.
- Make additional weather and coastal water-level data available in real-time.
- Develop and expand working relationships with hazard mitigation and response organizations.

Data Delivery and Availability

- Continue the transition to digital and interactive data delivery with new and upgraded interactive maps.

- Produce Energy and Mineral Section databases for public access to analytical data.
- Make the new GMC inventory database available for searching via the internet.
- Launch a redesigned website that provides users with easier access to the Division's products and services.

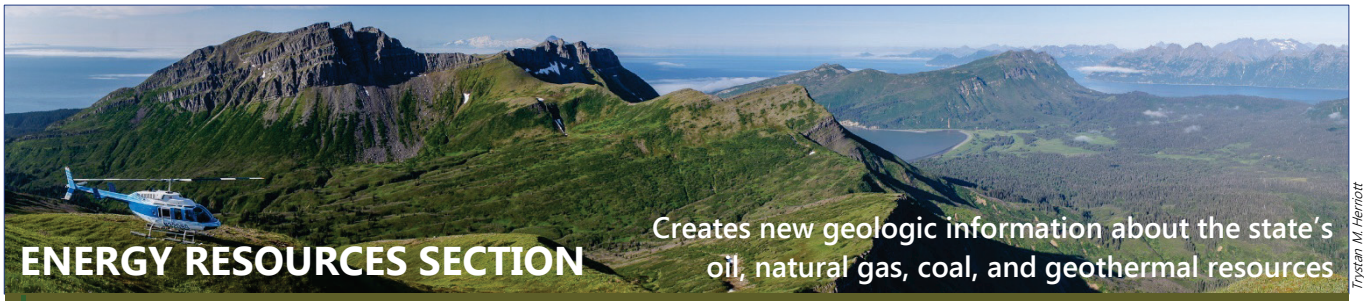
Geologic Materials Center

- Begin releasing seismic geophysical data through the facility.
- Complete the process of vacating the old facility.
- Increase outreach and education programs at the new facility to university, grade-school, middle school, and high school students.
- Transition to a fee-for-service model.

Volcanology

- Publish Alaska tephra glass geochemical data in an on-line searchable database
- 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 analysis of lake core tephras in the region
- Expand the Geologic Database on Volcanoes in Alaska (GeoDIVA) to hold tephra petrographic analyses.

A helicopter lands near the summit of Redoubt volcano where AVO installed an instrument to measure SO_2 emission from the cooling lava dome that was emplaced at the end of the 2009 eruption.

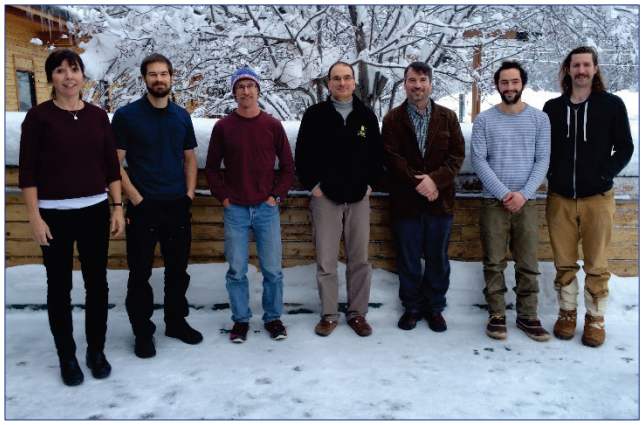


Trystan M. Herriott

View to south–southeast, showing outcrops of Upper Jurassic Chinitna and Naknek Formations on the Iniskin Peninsula, lower Cook Inlet. The Naknek Formation comprises the hill in upper left half of photo; Iniskin Bay is visible in upper right corner. The Naknek is oil stained along the south shore of Kamishak Bay, visible in the far distance in upper center of photo, and the Chinitna Formation (Paveloff Member) is oil stained to the north at Chinitna Bay.

BENEFIT TO ALASKA

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



Nina Harun, Trystan Herriott, Bob Gillis, David LePain, Marwan Wartes, Jacob Rosenthal, and Paul Wilcox

MAJOR PROGRAMS AND PROJECTS

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

MAJOR ACCOMPLISHMENTS IN 2015

Clues from Seeps, Sandstone, and Mudstone: Fieldwork completed in the Iliamna–Red Glacier area in Lower Cook Inlet

Robert Gillis

Two geologists (sitting, in red oval) note observations at the contact between maroonish-brown Late Jurassic Naknek Formation sandstone (uniform surface composing foreground) and a relatively thin wedge of locally oil-bearing orangeish-brown Maastrichtian(?) strata (middle view). A relatively thick package of medium gray Paleogene West Foreland Formation conglomerate scours the Maastrichtian(?) strata, and commonly removes it entirely along the Cook Inlet basin margin. Residual oil and oil shows have been encountered in Upper Cretaceous outcrops and well intervals, respectively, throughout the basin, indicating that these strata might make viable reservoir targets in Cook Inlet's lightly explored Mesozoic succession.

In summer 2015, DGGS mapped 150 mi^2 of bedrock geology exposed along the west side of lower Cook Inlet to enhance understanding of correlative strata comprising the deeper regions of the petroleum basin. Fracture-controlled oil seeps, sandstones containing residual oil, and organic-rich mudstones are present at the surface at several locations in this region, attesting to the potential for undiscovered hydrocarbon accumulations in deeper basin strata. Yet, little effort has been made since the mid-1960s to understand the petroleum potential of these rocks, and they remain only lightly explored despite more

than half a century of successful oil and gas production from fields in upper Cook Inlet. This new geologic mapping builds on contiguous bedrock mapping completed by DGGS in the region since 2013, and is supplemented by focused geologic investigations to more adequately understand the basin's petroleum source rocks, the potential for conventional and fractured reservoir systems, the stratigraphic framework of the deeper rocks, and their structural geometries. Many of these studies have already been published online and are available free to the public. Publication of the integrated, ~500 mi^2 bedrock geologic map is anticipated in 2018.

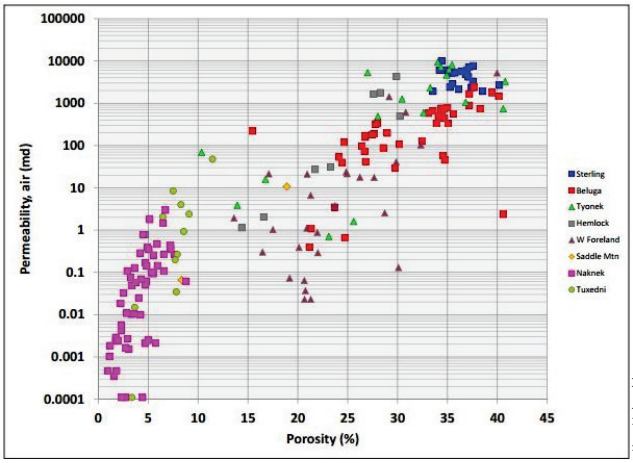
Cooking Coal to Generate Hydrocarbons: An Innovative Research Effort With the U.S. Geological Survey

Steve Masterman

Geologists collecting a channel sample through the Number 4 coal seam recently exposed in the Jumbo pit at Usibelli Coal Mine near Healy. The coal sample will be used in a hydrous pyrolysis experiment to determine if it is capable of generating liquid hydrocarbons under realistic subsurface conditions.

Previous investigations using Rock-Eval pyrolysis have suggested that certain coal samples from the Nenana, Susitna, and Holitna basins in Alaska, if they are buried deeply enough to reach the right level of thermal maturity, might have the potential to generate quantities of liquid hydrocarbons. This innovative research project will test the hypothesis that Alaska's coal can generate liquid hydrocarbons in the subsurface by conducting hydrous pyrolysis (HP) experiments on selected coal samples. The HP method was designed to replicate realistic subsurface conditions. If liquid hydrocarbons are generated during these experiments, it will prove that some Alaska coals are capable of generating petroleum liquids; this will spur exploration interest in several frontier basins in the state. A small suite of coal samples from the Nenana and Cook Inlet basins have been submitted to the U.S. Geological Survey for HP analysis.

Petroleum-Related Digital Data at Your Fingertips: Geodatabase Development Begins to Archive Important Petroleum-Related Data



Ken Helmold

A plot of air permeability versus porosity for Mesozoic and Cenozoic sandstones in Cook Inlet basin. These data, and supporting information, comprise the initial phase of a searchable ArcGIS geodatabase.

DGGS has accumulated a vast amount of relevant petroleum-related geologic data over the past few decades and continues to gather new data. A searchable, digital geodatabase, using ArcGIS, is under construction; once finished, it will allow industry and the public to search for relevant geologic data throughout the North Slope, Cook Inlet, and other Alaska frontier basins. The initial phase consists of Cook Inlet reservoir quality data. A schema is being developed to accommodate all of the data generated by the Energy Resources Section.

Helping Reduce North Slope Exploration Risk: New, Central North Slope Data on Targeted Petroleum Source- and Reservoir-Rock Units

Marwan Wartes

View to the north–northeast, showing exposures of sandstone and conglomerate of the Upper Cretaceous to Paleocene Prince Creek Formation along the west bank of the Sagavanirktok River, central North Slope. Correlative strata in the subsurface to the north and northwest form part of the reservoir for several billion barrels of heavy oil.

To stimulate exploration for hydrocarbons in northern Alaska, the DGGS-led North Slope program produces new, high-quality geologic information. Several new publications (listed below) highlight important data from potential oil and gas source rocks as well as targeted reservoir intervals. These studies display the breadth of the projects, ranging from the Carboniferous-age oil-stained dolomite of the central Brooks Range to Cretaceous-age, organic-rich mudstone from the eastern North Slope, adjacent to ANWR. The studies include Cretaceous and Paleocene age sandstones exposed in the central North Slope that are correlative with similar rocks in the subsurface near Prudhoe Bay that contain billions of barrels of heavy oil. This work improves our understanding of the regional petroleum systems on State-owned lands and reduces exploration risk and potentially entices new investment in Alaska's core petroleum province.

Turning Over Rocks to Find Petroleum: Newly Released Data Looks at the Petroleum Potential of Interior Basins

Despite Alaska's endowment of plentiful natural resources, many parts of the state do not have affordable energy. For several years DGGS has been investigating the potential of interior sedimentary basins to produce energy for local use. Work has mostly focused on the underexplored Susitna, Nenana, and Yukon Flats basins, each of which has the appropriate geologic characteristics to potentially host hydrocarbons. It is unknown whether the geophysically defined Holitna basin has the requisite geologic characteristics to host hydrocarbons, but nearby outcrops of coal-bearing rocks in the McGrath Quadrangle suggest the possibility.

David LePain

View to the northeast, showing a multi-meter-thick coal seam exposed along Contact Creek in the southwestern part of the Susitna basin. Light gray mudstone and light tan sandstone overlie the coal. Coal seams similar to the one shown here represent potential source rocks for natural gas in the subsurface of this basin and other frontier basins in Alaska (Nenana, Yukon Flats, and Holitna basins).

The program's recent products include five published papers (listed below) on the geology of the Susitna basin that present important new information about the basin's stratigraphic and structural framework, reservoir quality, and coal quality. Ongoing work in the Nenana basin includes collaboration and support for a UAF research intern analyzing the seismic structure of the basin. Numerous seismometers were recently deployed in the region and are collecting new, high-resolution earthquake data to better define the tectonic development of the prospective basin. A recently published Rock-Eval dataset from coal-bearing outcrops in the central McGrath Quadrangle illustrate their hydrocarbon source characteristics and shed light on the petroleum potential of the Holitna basin.

NOTABLE ACHIEVEMENTS

- Published nine-chapter volume summarizing important new geologic observations related to the petroleum potential of Cook Inlet
- Published comprehensive study of the stratigraphy and geochemistry of Pebble shale, an important hydrocarbon source rock on the North Slope

- Published new data on depositional setting and sand body geometries of potential Upper Cretaceous–Paleocene reservoir rocks (Prince Creek Formation) on the east-central North Slope
- Published new stratigraphic data on an important carbonate reservoir interval targeted in Brooks Range foothills exploration
- Presented preliminary detailed geologic mapping and cross sections from the area surrounding several oil and gas discoveries on the central North Slope, including the Umiat oil field
- Successfully supported a UAF research internship project assessing the unconventional shale oil potential of Triassic rocks on the North Slope
- Co-authored a significant paper on North Slope stratigraphy in the journal *Cretaceous Research*
- Published five-chapter volume summarizing important new geologic observations on the gas potential of the Susitna basin
- Presented to Doyon Limited officials a technical summary of recent DGGS studies of the petroleum potential of the Nenana Basin
- Chaired topical session on oil and gas resource potential in Alaska and delivered six presentations at major regional geologic conference held in Anchorage

ENERGY SECTION PUBLICATIONS IN 2015

Preliminary characterization of brittle deformation on the Iniskin Peninsula: Implications for the kinematic history of the Bruin Bay fault system, lower Cook Inlet, Alaska, by P.M. Betka and R.J. Gillis, 2015: Alaska Division of Geological & Geophysical Surveys Preliminary Interpretive Report 2014-5, 14 p. doi:10.14509/29130

Source-rock potential of the Lower Cretaceous Pebble shale unit, northeastern Alaska, by D.A. van der Kolk, M.T. Whalen, and M.A. Wartes, 2015: Alaska Division of Geological & Geophysical Surveys Preliminary Interpretive Report 2015-1, 37 p. doi:10.14509/29401

Reconnaissance investigation of the Lisburne Group in the Cobblestone Creek area, Chandler Lake Quadrangle, Alaska, by J.A. Dumoulin and M.T. Whalen, 2015: Alaska Division of Geological & Geophysical Surveys Preliminary Interpretive Report 2015-2, 18 p. doi:10.14509/29403

Overview of 2014 energy-focused studies in Susitna Basin, south-central Alaska, and preliminary results, edited by R.J. Gillis, 2015: Alaska Division of Geological & Geophysical Surveys Preliminary Interpretive Report 2015-3, 34 p. doi:10.14509/29408

Depositional environments of the Prince Creek Formation along the east side of the Toolik River, Sagavanirktok Quadrangle, North Slope, Alaska, by P.P. Flaig and D.A. van der Kolk, 2015: Alaska Division of Geological & Geophysical Surveys Preliminary Interpretive Report 2015-4, 17 p., 1 sheet. doi:10.14509/29407

Energy-related studies during the 2014 field season, western Cook Inlet, Alaska, by M.A. Wartes, editor, 2015: Alaska Division of Geological & Geophysical Surveys Preliminary Interpretive Report 2015-5, 62 p. doi:10.14509/29455

Interpretations of seismic reflection data and structural cross sections for the Kavik River map area, Alaska, by W.K. Wallace, M.A. Wartes, P.L. Decker, P.R. Delaney, R.J. Gillis, A.M. Loveland, and R.R. Reifenstuhl, 2014: Alaska Division of Geological & Geophysical Surveys Report of Investigation 2011-3B, 19 p., 3 sheets. doi:10.14509/25399

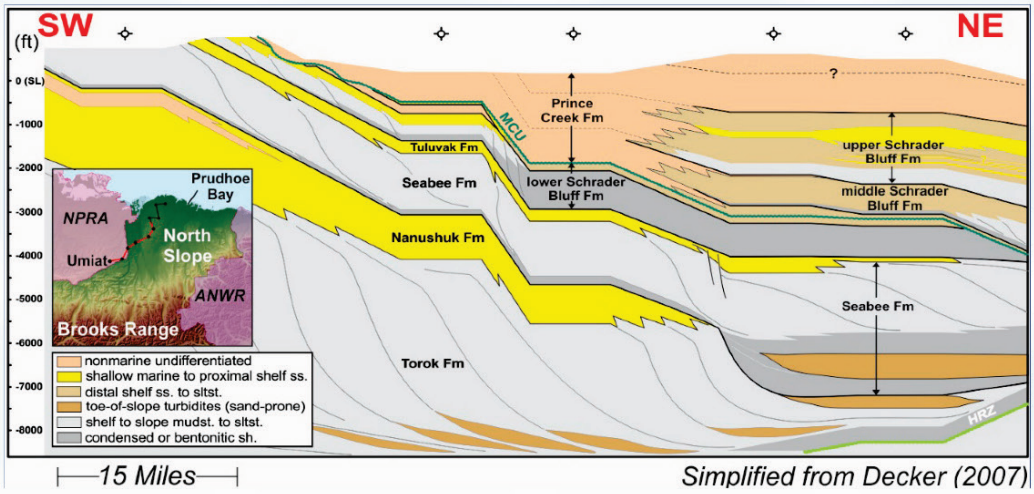
Geologic map of the south-central Sagavanirktok Quadrangle, North Slope, Alaska, by R.J. Gillis, P.L. Decker, M.A. Wartes, A.M. Loveland, and T.D. Hubbard, 2014: Alaska Division of Geological & Geophysical Surveys Report of Investigation 2014-4, 24 p., 2 sheets, scale 1:63,360. doi:10.14509/29138

Rock-eval pyrolysis, vitrinite reflectance, and kerogen microscopy results from Miocene carbonaceous mudstones and coals in outcrop, McGrath Quadrangle, southwestern Alaska, by D.L. LePain and Russell Kirkham, 2015: Alaska Division of Geological & Geophysical Surveys Report of Investigation 2015-3, 60 p., 1 sheet. doi:10.14509/29406

Marwan Wartes

View looking west showing geologists at an outcrop of the Lisburne Group on Tiglukpuk Creek during an industry tour led by DGGS.

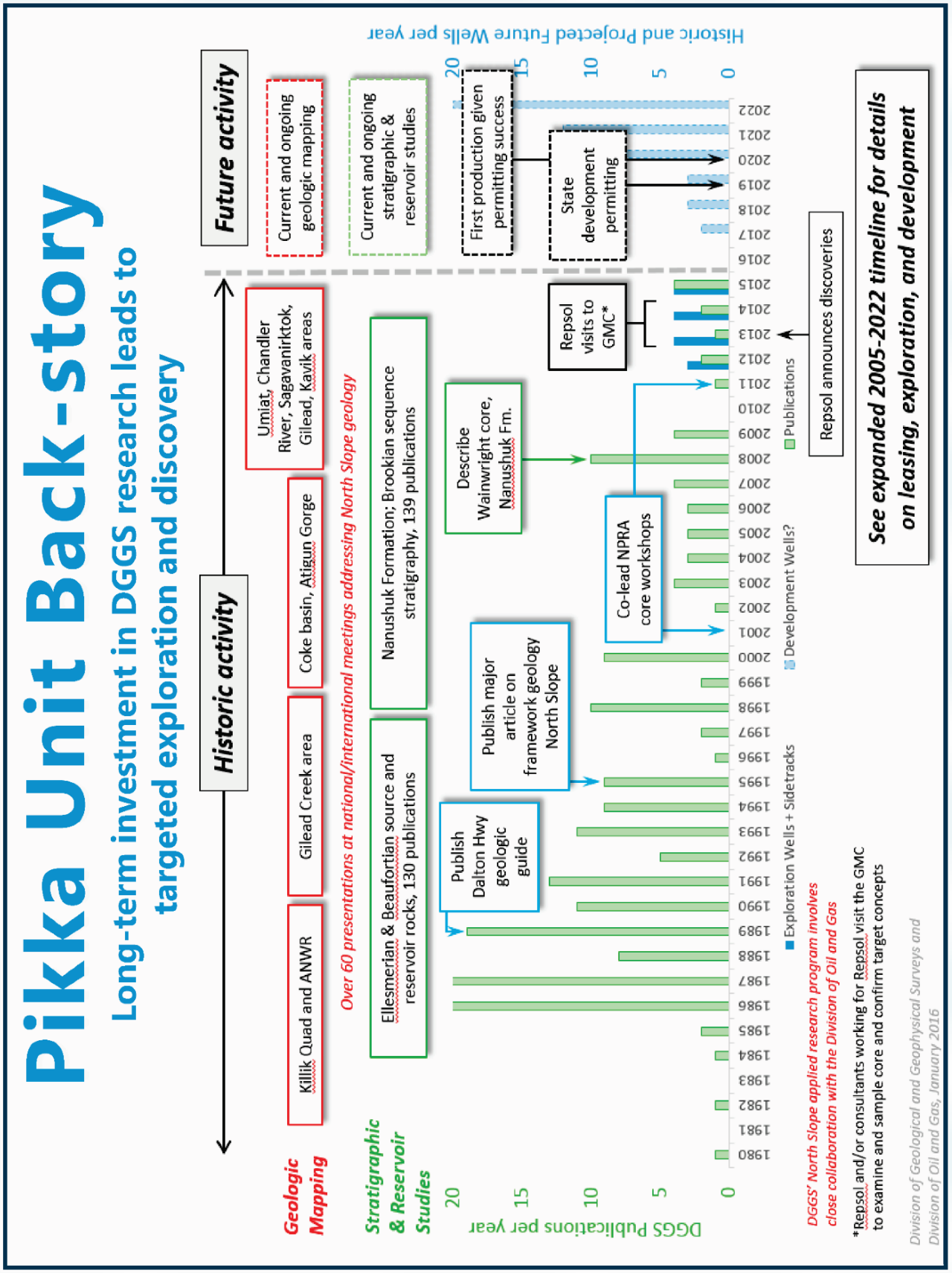
DGGS RESEARCH LEADS TO TARGETED EXPLORATION AND DISCOVERY



Onshore northern Alaska is one of the most prolific hydrocarbon provinces in North America. According to a 2012 U.S. Geological Survey assessment, 28 billion barrels of oil equivalent have been discovered (cumulative production plus proved reserves) in this province to date, and they estimate that the mean volume of undiscovered, technically recoverable resources is approximately 30 billion barrels of oil plus 181 trillion cubic feet of nonassociated gas. Finding and producing these resources requires high-quality, detailed information explaining the geology of the region, including the distribution of source and reservoir rocks. Since 2005, the Energy Resources Section, funded by an investment in energy-related geological research by the State, has published five bedrock geologic maps and numerous reports, supported several relevant graduate student 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 Formation, which includes one of the reservoir intervals in Repsol's and Armstrong's recent discovery in the Colville Delta area. A preliminary well test of their Nanushuk reservoir yielded up to 4,600 barrels of oil per day with no pressure drawdown, indicating a relatively large and continuous reservoir. Published estimates include contingent resources ranging from 500 million (1C) to over 3.7 billion (3C) barrels of oil. Producing this resource will generate significant revenue for the state treasury. Results from applied research by the Energy Resources Section contributes to discoveries such as this. Our work spurs exploration investment and development success by providing unique, high-quality, relevant information in the public domain to reduce investment risk. See "Pikka Unit Backstory" on the following page to see a detailed timeline of DGGS's historical activity leading up to the discovery.

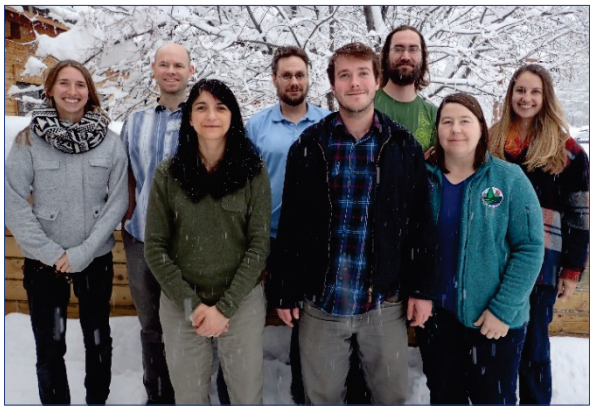
Photo shows the uppermost part of the Nanushuk Formation updip from the ultimate Nanushuk shelf edge. We infer that Repsol's Nanushuk reservoir is in correlative rocks in the subsurface to the north, and probably includes similar facies. Placing their discovery in a schematic sense on the cross-section above (Repsol's discovery is north of this cross-section), it would likely be in the northeast half of the yellow (marine) Nanushuk polygon. Abbreviations: ss. = sandstone; sltst. = siltstone; mudst. = mudstone; sh. = shale; Fm = Formation; MCU = mid-Campanian unconformity; HRZ = highly radioactive zone; NPRA = National Petroleum Reserve–Alaska; ANWR = Arctic National Wildlife Refuge.

DGGS RESEARCH LEADS TO TARGETED EXPLORATION AND DISCOVERY, continued



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.



Front: Jocelyn Simpson, Alexander Gould, De Anne Stevens. Back: Erin Whorton, Gabe Wolken, Trent Hubbard, Ronnie Daanen, Jacquelyn Overbeck.

MAJOR PROGRAM ELEMENTS

- Active Faulting
- Climate and Cryosphere Hazards
- Coastal Hazards
- Geohydrology
- Geologic Mapping and Corridor Studies
- Geologic Hazards

MAJOR ACCOMPLISHMENTS IN 2015

Finding Faults: Potential Seismic Hazards Along Proposed Alaska Gas Pipeline Route

We have completed a major new study evaluating potentially active faults in south-central and interior Alaska that could intersect the route of the proposed Alaska Stand Alone Pipeline (ASAP) project being considered by the Alaska Gasline Development Corporation (AGDC). The work focuses on the southern part of the proposed route that runs from the Livengood area to the Susitna lowland, generally paralleling the Parks Highway. This route is coincident with major portions of the AKLNG gas pipeline, and data collected is applicable and critical to both projects. We looked at the relative tectonic activity of each structure of concern, determined fault rupture parameters, and delineated the locations of possible fault/pipeline crossings on maps. The evaluation of existing data and imagery, helicopter reconnaissance, and new field investigations helped identify seven faults or fault systems that potentially intersect the proposed pipeline route and represent an active surface fault rupture hazard. While data on the active faults will be critical in designing and constructing pipelines that cross these structures, knowledge of

which faults are not active also has implications for planning and development, as seismic hazard mitigation will not be needed in these locations.

Glacier Runoff Report Paints Climate Change Picture for Proposed Susitna–Watana Hydroelectric Project: Climate and Cryosphere Hazards

Gabriel Wolken

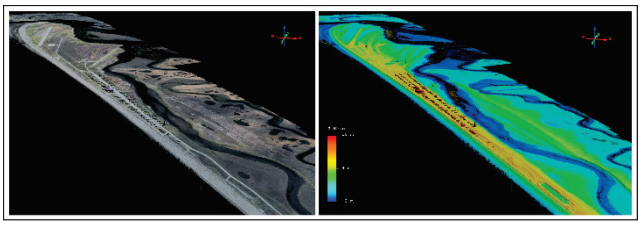
CCHP and UAF scientists installing weather and ablation monitoring station on West Fork Glacier.

Glaciers are significant contributors to seasonal river discharge in many parts of Alaska, serving as frozen reservoirs of water that supplement runoff during dry periods in which there is low flow. However, as climate warms and glacier melting and retreat increases, river discharge volumes and timing will change. This impacts water-resource management decisions, particularly in watersheds with existing or potential hydropower development. DGGS's Climate and Cryosphere Hazards program, along with collaborators from the University of Alaska Fairbanks, recently completed a 3½ year study of the effects of future climate variability on glacier mass loss and runoff in the Susitna River watershed upstream of the proposed dam site for the Susitna–Watana Hydroelectric Project. This study, funded by the Alaska Energy Authority (AEA), combined field measurements and computational modeling to estimate 21st century river discharge into the proposed reservoir, and to understand the basinwide contributions to river runoff and how these might change over time.

Although only about 4 percent of the upper Susitna watershed area is glacierized, changes to these glaciers over the next century will affect the quantity and timing of river flow into the reservoir. By the end of the 21st century, runoff is projected to decrease by 7.3 percent, with spring runoff occurring about 1 month earlier than it did at the beginning of the century and late summer runoff reducing to about half its original volume. These results provide AEA with important information necessary to properly evaluate how changes to the upper Susitna basin hydrology as a result of climate change and glacier mass loss will affect project operations and environmental resources over the anticipated lifespan.

New Technology Jumps Baseline Data Gap for Alaska's West Coast: Coastal Hazards

More than 60 percent of Alaskans live in coastal communities along 40,000 miles of coastline, yet much of the coast remains unmapped. The remoteness, vast scale, limited field season, and shortage of in-state resources contribute to the challenges of mapping Alaska's coast.



Three-dimensional model view of Shaktoolik in both true color (left) and color-indexed elevation (right).

Federal funding from the Coastal Impact Assistance Program (CIAP) is being used to help fill the gaps in critical coastal data by employing photogrammetrically derived elevation modeling using Structure-from-Motion (SfM), a state-of-the-art technology that efficiently and cost-effectively generates high-resolution digital image and elevation data. The unique SfM processing technique provides a true-color image and a digital surface model required for effective coastal hazard mapping. This work supports habitat-vulnerability assessments, oil-spill response, community planning, erosion/flood hazard mapping, and delineation of an updated shoreline position. These data are critical to prepare for and respond to coastal storms and for developing long-term adaptation strategies in response to climate change. In 2015 we contracted the collection and processing of high-resolution SfM orthoimagery (<20 cm ground sampling distance) and elevation models for Norton Sound and the Yukon–Kuskokwim Delta, an area that includes hundreds of miles of coastline and 29 coastal communities. Data for most of the area was successfully collected during the 2015 field campaign and will be made publicly available on our website in 2016.

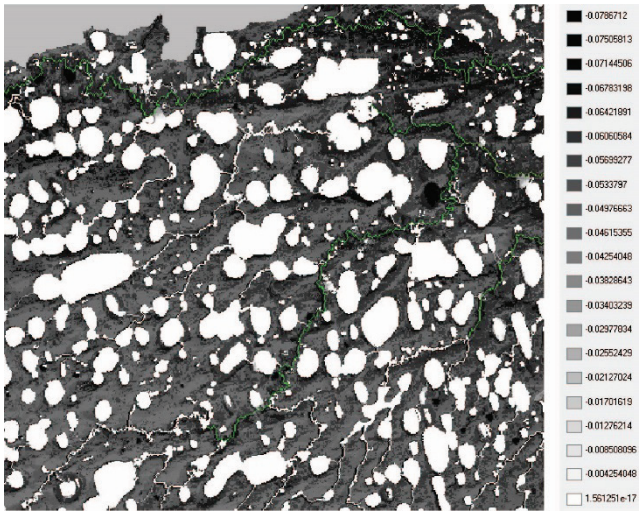
Attack of the Frozen Debris Lobes! A Lesson in Geologic Mapping and Corridor Studies

Frozen debris lobes (FDLs) are slow-moving landslides in permafrost. Made up of soil, rocks, trees, and ice, many of these features are present on slopes in the southern Brooks Range of Alaska. Because of the FDLs' close proximity to the Dalton Highway, Trans-Alaska Pipeline System, and proposed natural gas pipeline routes, and their anticipated sensitivity to changing climate, understanding the geologic hazard potential of these features is critical to the state's infrastructure and economic well-being. Recent public presentations and published reports on FDLs were important, as they allowed us to share findings in a timely manner with those needing the information for making important land-use and management decisions and to receive feedback from scientists and managers of impacted infrastructure. As of May 21, 2015, one FDL was 130.9 feet from the highway and advancing at a rate of 15.4 feet per year. At this rate, the FDL is anticipated to reach the highway in approximately 8 years; however, new rate-of-movement results indicate it is speeding up. This could mean that the highway will be impacted sooner. As a result, the Alaska Department of Transportation & Public Facilities (DOT&PF) is working on an accelerated schedule to reroute the road out of harm's way. We will continue to collaborate with University of Alaska Fairbanks researchers and DOT&PFto evaluate the hazards of FDLs.

State-of-the-Art Computer Models to Shed New Light on Water–Permafrost Interactions: Geohydrology

In 2013 we initiated a major new program to help assess the state's water resources. Our Geohydrology Program conducts research efforts focusing on understanding groundwater-related issues that impact the state and is currently involved in 13 individual projects. With an emphasis on understanding water availability on the North Slope to help foster potential unconventional energy development, the program is also investigating the effects of current and historic climate change on groundwater, the release of greenhouse gases, and degradation of permafrost.

A key success of the Geohydrology Program in 2014 was the development of high-performance computing capabilities for watershed-scale hydrologic simulations of the water balance. This computer modeling system was funded through small research grants in collaboration with the University of Alaska Fairbanks. We can now conduct rigorous, state-of-the-art, physically accurate simulations to understand water balance processes in Alaska and are actively developing algorithms to provide the most accurate groundwater information to planners and industry. The system is now being used to study the groundwater interaction with discontinuous permafrost in Goldstream Valley and to run simulations of the Fish Creek watershed in the National Petroleum Reserve–Alaska.



Ronald Daanen

Modeled simulation of Fish Creek watershed, NPR-A, showing depth to groundwater in grayscale, in an area with abundant lakes. These lakes are sometimes connected to streams when groundwater levels are high, thus allowing fish migration. Green lines are larger creeks and white areas are inundated and likely have surface water.

NOTABLE ACHIEVEMENTS

- Developed and refined Structure-from-Motion (SfM) aerial photography collection equipment and field protocols, and demonstrated capabilities through multiple field site collections: Alaska Range, Valdez ice-dammed lake, Richardson Highway/Thompson Pass, Mt. Redoubt, Sitka, Haines Highway, and Suicide Basin/Juneau.
- Published preliminary STATEMAP report that included surficial-geologic mapping for the Talkeetna Mountains C-4 Quadrangle and adjacent areas (scale 1:50,000). This region is in close proximity to the proposed Susitna–Watana hydroelectric project.
- Published completed surficial-geologic report and map of 875 mi^2 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 only in for part of the area.
- Working 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 used by DOT&PF for decision-making and infrastructure repair and maintenance.
- Enhanced the coverage of water-level networks through installation of new real-time water-level sensors throughout western Alaska in partnership with Alaska Ocean Observing Systems (AOOS) and the National Weather Service, Alaska Region.
- Published new online data and tools, including the Alaska Coastal Profile Tool and Alaska Shoreline Change Tool, to make coastal vulnerability maps and products with up-to-date information and an easy-to-use interactive display accessible to coastal planners and managers.
- Worked with DOT&PF avalanche professionals, UAF, and U.S. Geological Survey on innovative, state-of-the-art snow distribution and avalanche studies in south-central Alaska.

ENGINEERING GEOLOGY SECTION PUBLICATIONS IN 2015

Alaska Coastal Profile Tool (ACPT), 2014: Alaska Division of Geological & Geophysical Surveys Digital Data Series 7, http://maps.dggs.alaska.gov/acpt/. doi:10.14509/27359

Seismic and non-seismic influences on coastal change in Alaska—Fieldtrip guide and conference abstracts, 5th International Conference of IGCP 588, by N.L.M. Barlow and R.D. Koehler, compilers, 2015: Alaska Division of Geological & Geophysical Surveys Guidebook 12, 165 p. doi:10.14509/29179

Color-indexed elevation maps for flood-vulnerable coastal communities in western Alaska, by T.J. Tschetter, N.E.M. Kinsman, and A.M. Fish, 2014: Alaska Division of Geological & Geophysical Surveys Miscellaneous Publication 154, 20 p., 20 sheets, scale 1 inch = 500 feet. doi:10.14509/29129

Engineering-geologic map of the Dalton Highway from Galbraith Lake to Slope Mountain, southern Arctic Foothills, Alaska, by D.S.P. Stevens, 2014: Alaska Division of Geological & Geophysical Surveys Preliminary Interpretive Report 2002-3, 1 sheet, scale 1:63,360. doi:10.14509/25486

Contemporary shoreline retreat rates at Meshik in Port Heiden, Alaska, by N.E.M. Kinsman and A.I. Gould, 2014: Alaska Division of Geological & Geophysical Surveys Preliminary Interpretive Report 2014-4, 21 p. doi:10.14509/27321

Lidar data for the community of Golovin, Alaska, by L.E. Southerland and N.E.M. Kinsman, 2014, in Elevation Datasets of Alaska: Alaska Division of Geological & Geophysical Surveys Raw Data File 2014-20, 23 p. doi:10.14509/29127

Bathymetry of Valdez Glacier lake, by G.J. Wolken, A.A. Arendt, and J.L. Rich, 2015: Alaska Division of Geological & Geophysical Surveys Raw Data File 2015-1, 1 sheet. doi:10.14509/29255

Single-beam bathymetry data collected in shallow-water areas near Gambell, Golovin, Hooper Bay, Savoonga, Shishmaref, and Wales, Alaska, 2012-2013, by N.E.M. Kinsman, 2015: Alaska Division of Geological & Geophysical Surveys Raw Data File 2015-2, 15 p. doi:10.14509/29348

Tsunami inundation maps of Cordova and Tatitlek, Alaska, by D.J. Nicolsky, E.N. Suleimani, and R.D. Koehler, 2014: Alaska Division of Geological & Geophysical Surveys Report of Investigation 2014-1, 49 p. doi:10.14509/27241

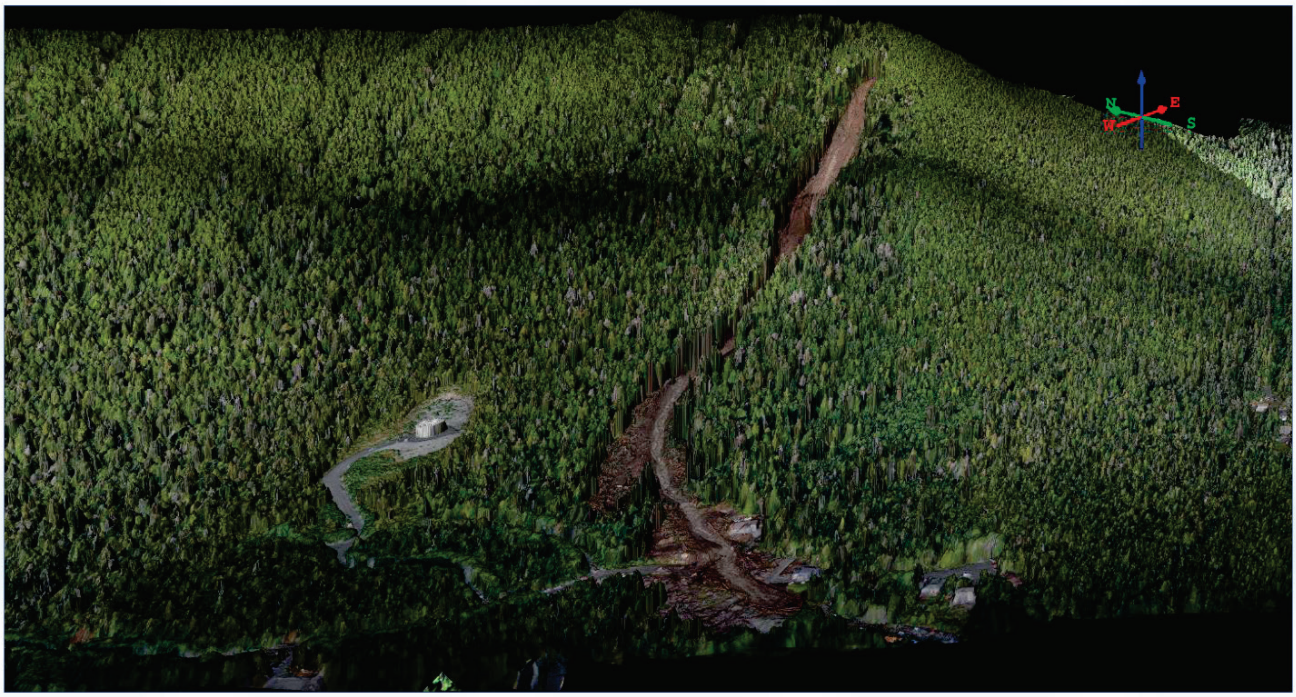
Tsunami inundation maps of the villages of Chenega Bay and northern Sawmill Bay, Alaska, by D.J. Nicolsky, E.N. Suleimani, and R.D. Koehler, 2014: Alaska Division of Geological & Geophysical Surveys Report of Investigation 2014-3, 50 p. doi:10.14509/29126

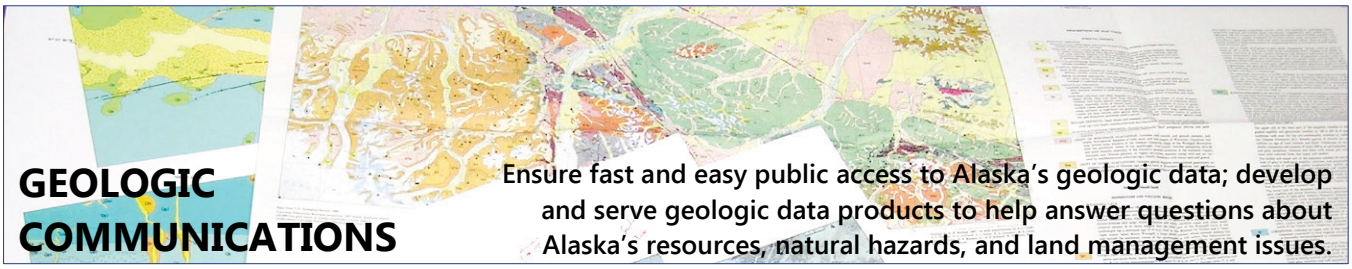
Tsunami inundation maps of Elfin Cove, Gustavus, and Hoonah, Alaska, by E.N. Suleimani, D.J. Nicolsky, and R.D. Koehler, 2015: Alaska Division of Geological & Geophysical Surveys Report of Investigation 2015-1, 79 p. doi:10.14509/29404

RAPID RESPONSE TO DEADLY AUGUST 2015 SITKA SLIDE

On August 18, 2015, heavy rainfall and wind resulted in numerous landslides in and around Sitka, Alaska. More than 45 landslides were initiated during this event and are documented 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.

The Engineering Geology Section responded immediately to the Sitka debris-flow events by providing rapid-response geologic hazards support. We conducted both ground- and air-based investigations of the debris flows and adjacent areas, acquiring aerial photographic data from which a high-resolution orthophoto mosaic and digital surface model (below) were produced for debris-flow mapping and analysis. Initial hazards evaluation by a joint DGGS–DOT&PF team provided critical information to Sitka emergency responders regarding the nature of the debris flows, and if there should be any concern for additional slope failures that would pose an immediate threat to rescue personnel or the residents of Sitka. Once initial response and recovery activities were completed, DGGS joined the Division of Homeland Security and Emergency Management's hazard mitigation team to provide additional field observations and ground-based mapping in support of community safety, cleanup, and future planning. DGGS's expertise in mapping and evaluating geologic hazards is an important State asset for ensuring Alaska's public and infrastructure safety.





GEOLOGIC COMMUNICATIONS

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

BENEFITS TO ALASKA

Information availability creates value: Basic 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.

Protect lives and reduce 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 infrastructure.

Back, L–R: Ken Woods, Joni Robinson, Mike Hendricks. Middle: Linda Natrop, Patricia Gallagher, Susan Seitz, Bobby Kirchner, Simone Montayne. Front: Paula Davis, Jen Athey.

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 division's computing resources
- Account for and maintain critical field safety equipment

OUR AUDIENCES

Provide access to scientific information to private industry, agencies, and researchers, as well as interpreted information to non-scientists, through personal contact, paper, and digital media.

- Tourists visit our office for road guides and to look at display rocks and fossils.
- Private citizens contact us about property issues such as sinkholes.
- Artists ask about locations of carving stone and clay suitable for pottery.
- Teachers contact us for curriculum materials such as topographic maps.
- Rockhounds ask about collecting sites for fossils and minerals.
- Miners want to know how to use maps and geophysical data to find gold.
- Exploration companies want our analytical data to look for resources.
- State agencies need our information for land-use plans and other projects.

OVERVIEW

What Keeps Us Up at Night: The Digital Backbone of DGGS

Provide public access to information by developing and delivering publications, websites, and online applications. The section's staff design, edit, publish, and deliver Division-generated geologic information as authoritative, peer-reviewed maps, manuscripts, geospatial datasets, and easy-to-use online applications. Their publication, GIS, and cartographic services enabled geospatial data analysis and map publication for almost 5,000 mi^2 of new geologic mapping and airborne geophysical data in FY15.

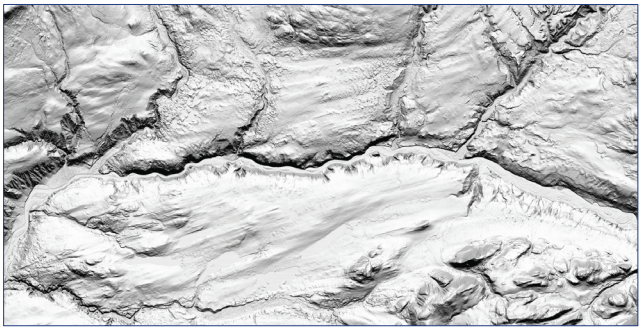
Archive and provide user-friendly access to digital and map-based geological, geophysical, and geochemical data from a Division-wide database they designed, created, and continue to maintain. It

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 11 million page views in FY15.

Provide 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 system 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 Web Maps, Finally! Elevation Datasets in Alaska



To support the Division's geologic research requirements, our staff search for and acquire elevation data and have created a new "Elevation Datasets of Alaska" web application to make that data publicly available. The web app allows users to view and download all known, publicly available LiDAR, IfSAR, and photogrammetrically derived elevation-based datasets covering Alaska. This data is more accurate than available topographic mapping. New data is added as it becomes available.

As of summer 2015 the web app hosts 2.5 terabytes of elevation-related data. In addition, select elevation datasets are available as geospatial services that allow users to make use of this elevation data using their own GIS or custom application. The data is valuable to a vast audience including federal, state, and municipal users, as well as academia, private companies, and individual users.

Additional helpful geospatial online applications can be found on our website at maps.dggs.alaska.gov.

Where Are My Rocks? Inventory Management Tool for Alaska's Geologic Materials

Geologic Communications Section staff members created the Geologic Materials Center's spatially-aware, end-to-end inventory management tool to track the center's priceless collection of core, cuttings, slides, geologic samples and analyses, and more. The tool will allow more users to access the details of the collection—while onsite and from offsite—and will facilitate more widespread use of the multi-billion-dollar collection of samples. With smaller exploration companies in the search for resources in Alaska, there is a much stronger need for available baseline data from previous drilling and exploration projects. The information at the Geologic Materials Center will augment and influence their research and enable them to invest money into additional drilling in a shorter timeframe.

The new inventory control system proved invaluable during the physical move of the collection from an old, terribly inadequate storage facility to a new, state-of-the-art Geologic Materials Center and helped to maintain organization of the many truckloads of samples during the move and for individual sample locations in the new building.

The database generates reports, allows easy searching of the inventory database, performs auditing functions, and provides quality assurance. The robust system offers everything you'd expect in inventory management, but is tailored to the specific

needs of a geologic materials center. It tracks wells, boreholes, stratigraphy, publications, outcrops, and more; it can search by quadrangle, mining district, and other options, or by simply drawing a box on a digital map. It was designed to be efficient, and can search the 500,000-plus item inventory in less than 100 milliseconds.

Asbestos in Rocks: New Maps Show Likelihood of Naturally Occurring Asbestos

Chrysotile (UAMES 34962) collected from Dahl Creek, Cosmos Hills area, Kobuk District, Alaska, by Eskil Anderson.

For years, asbestos has been linked to fatal lung diseases such as asbestosis, lung cancer, and malignant mesothelioma, which have been associated with asbestos that was mined, milled, or used in manufacturing processes or where man-made products containing asbestos were installed or disturbed. More recent studies have examined environmental exposure to asbestos in natural rock outcrops and resulting gravel and soils. While levels of airborne asbestos can be expected to be higher where these deposits are disturbed, it is not yet clear how low-level environmental exposure affects health, or what levels are safe. It is wise to have prior knowledge of whether the local geology could contain asbestos, to enable residents to minimize potential risk from disturbing these deposits.

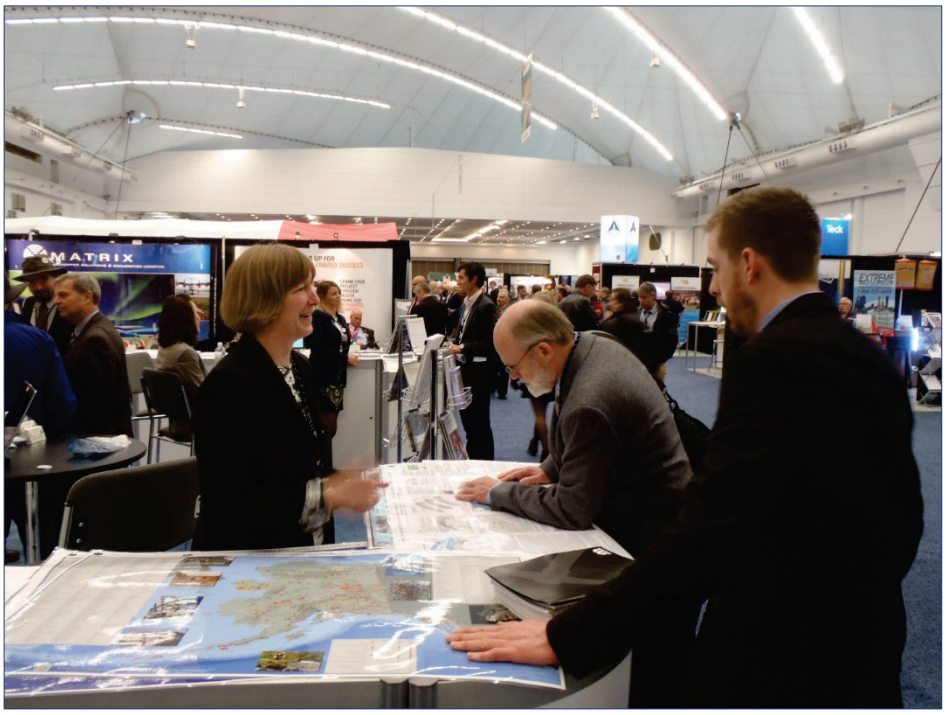
In a project for the Department of Transportation & Public Facilities (DOT&PF), the section created maps showing the likelihood of naturally occurring asbestos (NOA) being present in Alaska's bedrock. Areas of NOA potential and known asbestos occurrences are portrayed on 21 maps that cover Alaska, with a color-coded scale ranging from High-to-Known through Zero-to-Low potential. The maps are a guide to places where bedrock might contain natural asbestos; however, local geology must be examined carefully and samples collected and tested to verify the actual presence and amount of NOA in an area. The maps and accompanying report are available for download at doi:10.14509/29447.

NOTABLE ACHIEVEMENTS

- **Products:** Distributed 385,336 hardcopy maps and reports, online PDFs, and digital datasets during FY15. Produced 55 new publications for the division's scientific staff. Maintained and added data to existing online interactive applications and added the new Alaska Shoreline Change tool.
- **Responses:** Responded to 64 "Ask a Geologist" questions from our website.
- **Streamlining:** Publishing geochemistry analyses and geophysics data releases can now be completed within about 1 month from receipt of results from contractor. The efficiency was gained by the Geo-Comm Section staff completing much of the tedious data entry work formerly done by minerals staff.
- **Archiving:** Acquired, cataloged, and preserved important geologic materials (paper documents/maps, digital media, physical samples) on which the State's geologic analyses and geologic knowledge are based. In 2015, staff tackled 20+ cabinets of unsorted files, creating almost 300 new records in our publicly accessible archiving application, Alaska Geologic Data Index (AGDI), maps.dggs.alaska.gov/agdi. The app includes an index of materials from 60+ years of geologic work in remote areas of Alaska.
- **Dependability:** Division IT staff again kept the division's network, data sharing, and online applications running with nearly zero downtime with forward planning and creative use of resources (on a seriously tiny budget).
- **Training:** Provided geospatial fundamentals education classes to DNR and other State employees, addressing the need to increase the State's productivity in core GIS knowledge areas of imagery, elevation, and map production. Using in-house staff to teach the basics allowed contracted instructors to conduct more complex GIS classes with employees.
- **Contributed** 60 DGGS publication records to the USGS's National Geologic Map Database that will be searchable in their publicly accessible MapView application and Catalog Search. ngmdb.usgs.gov/ngmdb
- **Archiving:** In FY14 the USGS National Geological & Geophysical Data Preservation Program (NGGDPP)

funded inventory of current and legacy geologic field photos, preservation of part of our scanned field photo collection, and development of an alpha-tested open-source data entry web application to easily capture future digital photo information.

- **Archiving:** Initiated NGGDPP-funded FY15 project to preserve energy-related project materials produced by former DGGS geologists Gil Mull and Ellen Harris. The materials represent a cumulative 60 years of seminal work in remote northern Alaska, some of which directly led to the exploration of, and subsequent discovery of, the Prudhoe Bay oil field and is still relevant to modern regional oil and gas exploration.
- **Served** on community-of-use technical committees for the development of national geologic data standards and the USGS topographic data program.
- **Accessibility:** Began revamping the Division website to create easier access to DGGS products and data, developing additional content for our audiences, and streamlining by creating automations where possible.
- **Maintenance:** Continued maintenance and support of existing applications: • Publications application, • Webgeochem, • Digital Data Distribution system, • Geologic Map Index of Alaska, • Airborne GeophysWeb, • Alaska Geologic Data Index, and other web mapping applications in our Digital Data Series.
- **More Data:** Loaded and quality controlled geochemistry data from 54 legacy publications from U.S. Bureau of Mines and U.S. Geological Survey, accounting for analyses of 26,963 unique samples in the Webgeochem application.
- **Accessibility:** Developed customized biography web pages for DGGS geology staff, highlighting experience, expertise, and publications to help the public and our customers find the staff member with the knowledge they need.
- **Worked with Coastal Hazards staff** to create the Alaska Shoreline Change Tool, which uses historical shoreline changes to predict future shoreline locations for Alaska Coastal Communities with available data. The application includes 10 areas so far.



Melanie Werdon, representing the Alaska Division of Geological & Geophysical Surveys, addresses questions from attendees at the Association for Mineral Exploration British Columbia Mineral Exploration Roundup conference in Vancouver. The conference was attended by more than 6,600 participants from 36 countries and 6 continents.

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 Geologic Materials Center (GMC) provide baseline geologic data, and access to samples from prior exploration efforts is critical for exploration and resource management in the state. The information they provide will likely help discover new or additional oil and gas reserves, regions of viable geothermal energy, 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 a discovery and ultimately to millions of dollars in revenue to the State as well as hundreds of local jobs.

From left: Alexandra Busk, Kurt Johnson, Natalie Tyler, Jean Riordan.

OVERVIEW

The Alaska Geologic Materials Center 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 understanding 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 new GMC facility at 3651 Penland Parkway, Anchorage.

The GMC is operated by the Alaska Department of Natural Resources, Division of Geological & Geophysical Surveys (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 & 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

Not Your Ordinary Rock Collection: Industry Takes Advantage of Extensive State Geologic Sample Archive

Mineral resources have underpinned Alaska's economy since the late 19th century. Alaska's mineral deposits result from the fortuitous but complex assemblage of dozens of land fragments derived from across two oceans and two continents. Over the past several years geologists from Millrock Resources have searched southwestern Alaska with an eye toward the copper and gold potential of volcanic-hosted porphyry systems. Millrock has viewed and analyzed

Millrock Resources employee Cody Pink helps slab more than 500 meters of core from the Mallard Duck Bay volcanic-hosted porphyry system in southwestern Alaska.

GMC mineral core from the Estelle, Kemuk (Humble), Bee Creek, and Mallard Duck Bay prospects to augment their exploration efforts.

Geologists from independent and major energy companies often visit the GMC to examine hundreds of feet of well core and cuttings. With the declining production from the mature Prudhoe Bay oil fields it is essential to diversify the oil industry in Alaska. The GMC has hosted visits by independent oil companies operating in both the North Slope and Cook Inlet regions that include Apache Corporation, Great Bear Petroleum, Escopeta Oil and Gas, NordAq Energy Inc., Hilcorp Alaska LLC, Repsol USA, Armstrong Oil & Gas, Linc Energy, and Cook Inlet Energy. After numerous visits to the GMC over four years and running a large 3-D seismic program, Houston-based Apache Corporation drilled one well at a prospect on the west side of Cook Inlet. Successful exploration efforts similar to Apache's will lead to discovery and ultimately to millions of dollars in lease, tax, and royalty revenue to State government.

Finding a Zircon Crystal in a Haystack: New Inventory Database and Barcoded Samples Make Collection More Accessible

An integral part of the facility's relocation was the development of a robust database. Intensive efforts by GMC and GeoComm staff produced an online information system that allowed more than 500,000 scans of boxed inventory at both facilities during the move. Using barcodes and scanners, the system tracked each step of the relocation of more than 100,000 pieces of inventory, allowed for efficient designation of inventory to new shelves, and audited all inventory at both facilities. Before 2016 the GMC will release a public, searchable webmap for more than 500,000 samples in its inventory. The browser-based tool (maps.dggs.alaska.gov/gmc) allows users to build simple to 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 to exactly replicate the user's inventory results. All user search results can be easily transformed into PDF or CSV formats for download to a local computer.

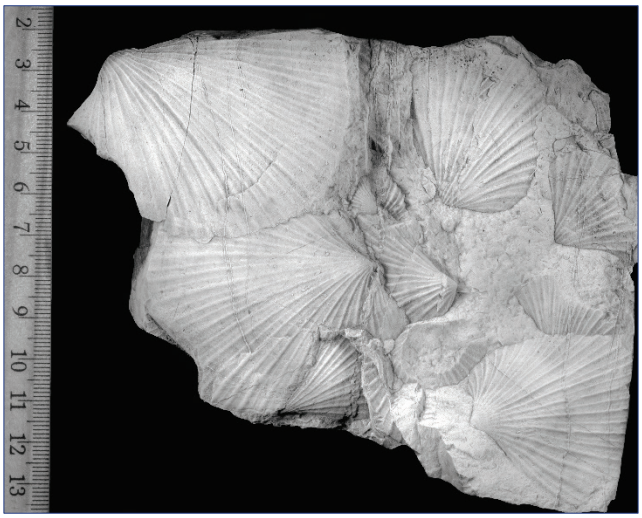
GMC intern Alexanda Busk scans newly arrived inventory before shelving boxes.

Collection Highlights

2,039	mineral boreholes
2,829	oil & gas wells
106,000	linear feet of oil & gas core
195,000	processed slides and thin sections
300,000	linear feet of mineral core
336,000	surface and seismic shot-point samples
48,000,000	representative feet of oil & gas core chips and cuttings

Even Rocks Need a Little Love: The GMC's Ongoing Sample Curation Effort

Care for samples and sample boxes is greatly reduced at the temperature-controlled new facility. Significant time previously spent stabilizing physical inventory can now be shifted to research on many scores-of-thousands of samples that are not connected to associated geolocation and geologic metadata. This lack of information threatens to make exceptionally difficult any effective use of large sections of the GMC collections by the geologic community. Federal grants, such as the USGS-sponsored National Geological and Geophysical Data Preservation Program (NGGDPP), are an important part of ongoing GMC goals to provide orderly and well documented samples to clients. Through this federal program the GMC recently finished a multi-year project to stabilize samples, replace inadequate storage containers, provide detailed inventory information, and associate necessary metadata for samples of approximately 50,000 feet of representative BOM drill core and more than 104,000 surface BLM pulp samples. Surface samples will continue to be an area of vital inventory and research.



Robert Blodgett

High-contrast image of Norian age (Upper Triassic) Monotis subcircularis. *Collected by USGS geologist William W. Patton, Jr., on St Lawrence Island in 1971 and identified by paleontologist Robert B. Blodgett. The fauna and host lithology indicate similarity with northwestern Brooks Range Otuk Formation.*

One of the exciting products of increased curation of the outcrop collections is the unearthing of thousands of megafossils that had been boxed for decades. This study will ultimately lead to Alaska biostratigraphic reference collections and possible new insights into Alaska's geologic history.

UAA Geology Students Rock! University of Alaska Anchorage Students Put On Core Workshop

Kurt Johnson

Professor Dr. Jennifer Aschoff (center), helps UAA stratigraphy students Chloe Ivanoff (left) and Dawn Loxley (right) as they begin their examination of NPRA well cores.

Public outreach at the GMC was highlighted this year by the second annual core study and public workshop organized by UAA Associate Professor of Geology Dr. Jennifer Aschoff. This stratigraphy course is designed to challenge and extend the scientific capabilities of Junior-level geology majors through interaction with geologic professionals and gaining hands-on experience analyzing hydrocarbon source and reservoir rocks. Students were exposed to a wide range of North Slope Alaska rock units that included the Sag River, Nanushuk, Torok, and Ivishak Formations and the Lisburne Group. Well cuttings and core from multiple wells are utilized in exercises to observe sedimentary rocks and use sedimentary structures, fossils, and rock compositions to determine depositional environments. To complement the analytical skills, students present their results to both the public and the geologic community. Students advance professional collaborative skills by presenting their observations and conclusions in poster sessions with judges from BP, Conoco-Phillips, AOGCC, DOG, USGS, and UAA. Also in attendance was a judge from Pango Media and eight secondary home-school students from Eagle River.

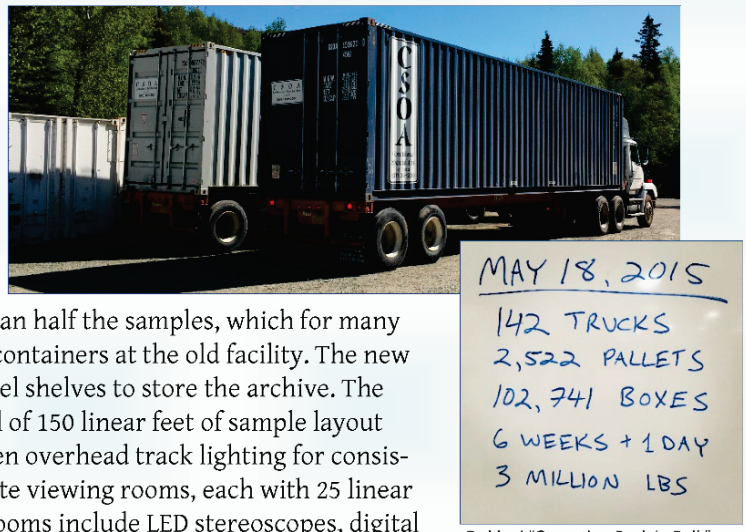
NOTABLE ACHIEVEMENTS

- The new Anchorage GMC facility is organized, audited, and open for business only six weeks after relocation from the former Eagle River campus.
- Safely decommissioned five buildings and 60 metal storage containers used during operation of the former Eagle River repository.
- The Alaska Oil and Gas Conservation Commission (AOGCC) added 412 boxed sample sets of recently drilled energy wells to the GMC collection.
- Two GMC internships provided practical geology experiences for Alaska undergraduates.

BP Exploration (Alaska) donated more than 130 pallets of oil and gas rock samples to the GMC in August 2015. This donation adds over 900 new Alaska wells to the facility's oil and gas collection.

NEW GEOLOGIC MATERIALS CENTER: THE "BIG MOVE"

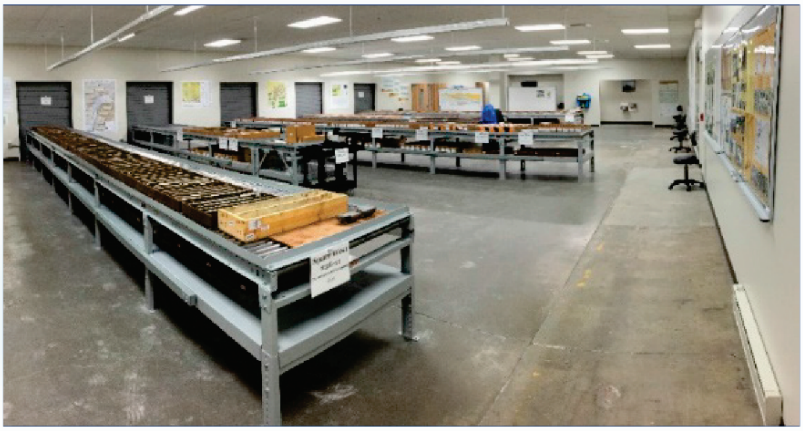
On July 1, 2015, the GMC reopened all of its collections to the public at the new 90,000 ft² Anchorage storage facility. Relocation to Alaska's largest population center will increase access to facility services by the geologic community and the public. Nearly 3 million pounds of rock samples and materials were safely moved from Eagle River to Anchorage in just over six weeks. The new indoor, temperature-controlled environment dramatically diminishes the freeze-thaw degradation for more than half the samples, which for many years had been stored outside in 57 metal shipping containers at the old facility. The new facility features more than 5,000 eight-foot-wide steel shelves to store the archive. The main viewing room has five roller tables with a total of 150 linear feet of sample layout space. All layout tables are equipped with high-lumen overhead track lighting for consistent and high-visibility sample viewing. Three private viewing rooms, each with 25 linear feet of layout space, are also available. All viewing rooms include LED stereoscopes, digital balances (accurate to 0.1 g), and minor sampling equipment. Also available are high-quality petrographic and stereographic microscopes with a digital camera attachment. The sample preparation room features rock saws, a plugging drill press, and a vented chemical hood.



Dubbed "Operation Rock 'n Roll," day-to-day progress of the GMC relocation project was tracked on a large whiteboard in the warehouse receiving area.

In 2015 the GMC successfully continued long-term archiving and curation of inventory; it fulfilled sample requests from industry, government, and university geologists, and promoted educational use of samples, training students, and hosting public tours. A catalog of more than 515,000 samples allows clients access to preliminary and advanced analysis of extensive, remote, and often restricted sections of Alaska. Recent visits by Shell Oil exploration geologists honed interpretation of the Burger well region of the Chukchi basin. Before the transfer of selected BP Alaska North Slope properties to Hilcorp, geologists from both companies examined donated Shell Oil cores from the Milne Point area. Geologists from Repsol visited the GMC several times over the past three years to gain knowledge and insight on the Beaufortian reservoirs in their recently announced discovery in the Colville Delta area. The Alaska Land Trust Office utilized Bureau of Mines materials from the Cape Yakataga area to better focus 2016 field operations for resource evaluation of the region. Significant volumes of well materials permitted teams of Federal and university geologists to enhance their understanding of Alaska energy basins on the North Slope, Cook Inlet, and the Gulf of Alaska.

Funding for Alaska's Permanent Fund Dividend and the operation of State government is not the only item of value that comes out of State subsurface lands. Exploration and development of Alaska's resources also generates a tremendous wealth of rock samples, laboratory analyses, and geologic information. While advancing technologies provide powerful geophysical tools for exploring wide swaths of our state, access to physical rock samples is still the single greatest source of geologic truth. Each year, GMC samples are inspected or analyzed by 400–500 clients from industry, government, and academia. Every one of the 500,000 rock samples at the GMC represents a significant piece of Alaska's ancient and complicated subsurface puzzle. As a publicly funded geologic sample repository, the Geologic Materials Center makes these at-risk collections accessible to help advance exploration and knowledge of Alaska's natural resources.



Samples are brought in from the warehouse through custom-built, roll-up doors and pushed 30 feet into the building on five roller tables.

Larry Freeman

Division Director and State Geologist Steve Masterman showing the vectors of principal stress direction of complexly folded quartz–schist of the Jarvis Creek Sequence in the Tok geophysical survey area. In 2015 DGGS published 989 mi^2 of airborne geophysical data coverage and conducted reconnaissance geologic fieldwork in the Tok area, which has potential for polymetallic massive sulfide deposits, gold vein deposits, and porphyry copper–gold–molybdenum deposits.

Larry Freeman

DGGS and UAF geologists at the start of multiple transects across the Hona pluton, which is host to gold mineralization and has been prospected for porphyry copper mineralization. The Hona pluton is in the Tok Geophysical survey area.

MINERAL RESOURCES

Improve the success of exploration and mining development and assess Alaska's mineral resources by providing accurate, timely, and available geological and geophysical information.

Strong quartz–sericite–pyrite with molybdenum mineralization peripheral to the Copper Joe porphyry copper–gold–molybdenum deposit near the headwaters of the Styx River, western Alaska Range. DGGS geologists published a new age of approximately 10 million years for this alteration, making this the youngest known porphyry system north of the Alaska Peninsula. Kiska Metals Corporation integrated DGGS geophysical data with fieldwork to provide initial exploration targets for additional ground geophysics, geologic mapping, and drilling from 2013 through 2015.

BENEFIT TO ALASKA

The Mineral Resources Section researches and evaluates Alaska's undiscovered mineral resources using its expertise in mineral deposit geology, geophysics, geochemistry, and mineral-resource evaluations. Publication of this geologic and mineral-resource research and evaluation directly meets DNR's constitutional mandate to promote responsible development of Alaska's natural resources and the Division's statutory directive to determine the potential for production of metals and minerals on state land.

From left: Evan Twelker, Lauren Lande, Karri Sicard, Gina Graham, Melanie Werdon, Alicja Wypych, Larry Freeman, Abraham Emond.

OVERVIEW

High-Grade Information: Helping to Determine the State's Mineral Resource Potential

To determine the state's mineral-resource potential, Section staff conduct geophysical surveys, geologic mapping, mineral-resource assessment, and ore deposit research; they also track mineral industry exploration and discoveries, development, and production. Additionally, the Section's expertise and knowledge are sought to review other Departmental actions including State land selection conveyance prioritization, land-use plans, land disposal actions, review of federal actions, and infrastructure planning.

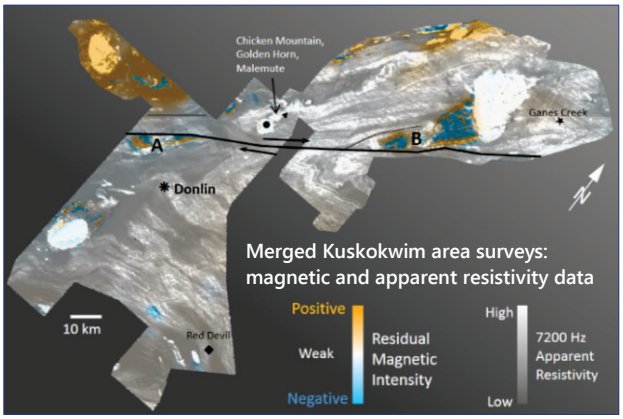
The geophysical, geological, and resource surveys conducted by the Mineral Resources Section not only inventory the potential for mineral resources, but they add value to the State in terms of current and future revenue. Over the last two decades the state has conducted airborne-geophysical surveys for 11 percent of State lands; in 2014, one-half of the State's mining claim revenue came from the Division's geophysically surveyed areas. The 2014 mining claim revenue averaged over all state lands was $0.08 per acre, but revenue was $0.37 per acre in areas covered by a geophysical survey.

ACCOMPLISHMENTS

Minerals Industry Naturally Drawn to Magnetic Data: 22 Years of the Airborne Geophysical/Geological Mineral Inventory Program

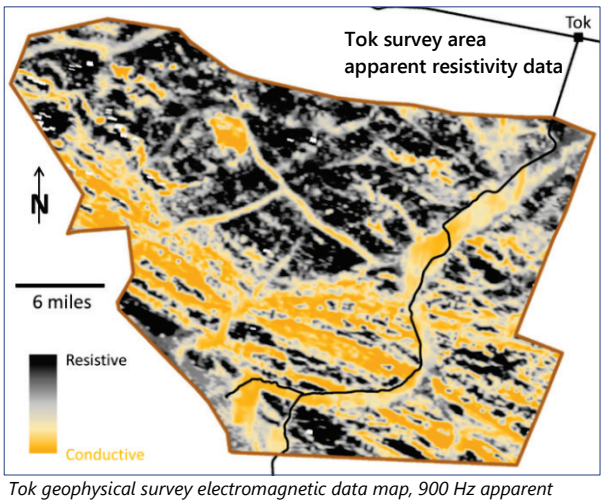
Goldak Airborne Surveys' data acquisition aircraft, Tanacross magnetic survey, June 2015.

Since 1993 the data products of the Airborne Geophysical/Geological Mineral Inventory (AGGMI) program have been an important component of successful resource exploration programs; products have contributed to the private-sector discovery of more than 22 million ounces of gold in the Salcha River–Pogo and Livengood areas.



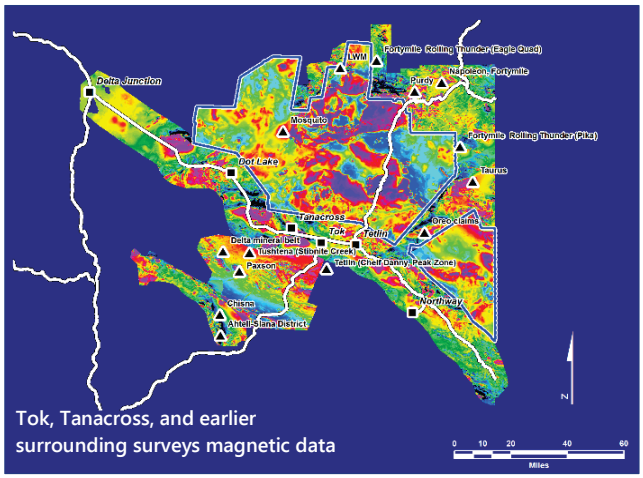
Resistivity and magnetic data composite map of Southern Dishna, Iditarod, Beaver Creek, Sleetmute, Aniak, and Fox Hills geophysical surveys. Excellent stratigraphy is visible in apparent resistivity data. Right-lateral Iditarod–Nixon Fork fault is drawn and clearly visible in resistivity data. Volcanic rocks A and B have similar magnetic signatures and are offset by 90 km.

Airborne geophysical data is used to assist with geologically mapping an area, particularly in areas with poor bedrock exposure. Minerals exploration companies routinely use DGGS airborne geophysical data in their exploration programs. Exploration, discovery, and resource development contribute significantly to the state's economy and tax revenue.



Tok geophysical survey electromagnetic data map, 900 Hz apparent resistivity grid. Excellent stratigraphy of Hays Glacier belt schists visible as linear east–west features in middle of map.

DGGS collected 4,500 mi^2 of airborne geophysical data and published more than 9,500 mi^2 of data in maps and digital data for download during 2015. The largest of the surveys collected and published in 2015 was the Federally funded Tanacross fixed-wing magnetic survey. The Tanacross survey was funded by the U.S. Geological Survey Minerals Program to support their Yukon–Tanana terrane mineral-resource potential analysis and fills in gaps between previous AGGMI datasets. Data collected in previous years from the Southern Dishna River, Fox Hills, Beaver Creek, Farewell, Middle Styx, Tok, and Tonsina helicopter-borne electromagnetic and magnetic surveys were published during 2015. Three older surveys, Livengood, Fortymile, and Petersville, totaling 1,680 mi^2, were updated and made available for download. Freegold Ventures Limited's Shorty Creek project used the Livengood magnetic data as a foundation for their 2014–2015 exploration program; Freegold Ventures recently announced a 2015 discovery drill hole targeting an airborne geophysics-delineated magnetic anomaly coincident with geochemical and other geophysical anomalies that encountered 300 feet of copper–gold–silver mineralization with values equivalent to 0.71 percent copper.



Tanacross region magnetic data map, eastern Alaska. Magnetic data from DGGS Tanacross (2015), Tok (2014), Ladue (2010), Slate Creek—Slana River (2008), Western Fortymile (2007), Alaska Highway Corridor (2005), and Fortymile (1998) surveys shown. The two-area Tanacross survey is outlined. Select mineralization localities are labeled with triangles. Major highways and towns (squares) are drawn on the map.

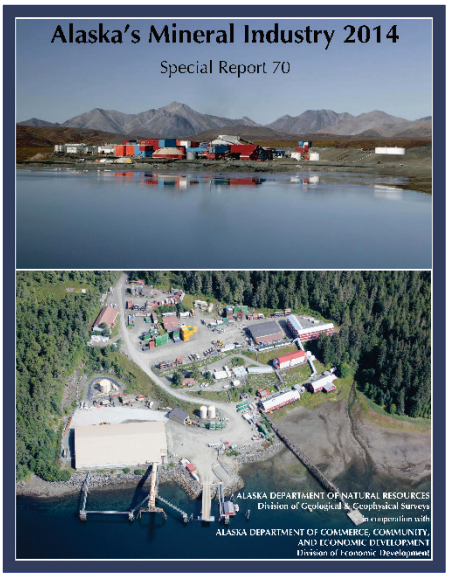
Tonsina electromagnetic and magnetic airborne geophysical survey data compilation, by A.M. Emond, CGG, L.E. Burns, G.R.C. Graham, and CGG Land (US) Inc., 2015: Alaska Division of Geological & Geophysical Surveys Geophysical Report 2015-1. doi:10.14509/29169

Tok electromagnetic and magnetic airborne geophysical survey data compilation, by A.M. Emond, CGG, L.E. Burns, G.R.C. Graham, and CGG Land (US) Inc., 2015: Alaska Division of Geological & Geophysical Surveys Geophysical Report 2015-2. doi:10.14509/29347

Airborne magnetic geophysical survey of the Tanacross region, Alaska, by A.M. Emond, R.W. Saltus, G.R.C. Graham, and Goldak Airborne Surveys, 2015: Alaska Division of Geological & Geophysical Surveys Geophysical Report 2015-6. doi:10.14509/29514

Getting the Word Out: Showcasing Alaska's Diverse and Substantial Mineral Potential

By publishing Special Report 70, Alaska's Mineral Industry 2014, and by presenting annual reviews of the industry 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 to "...make an annual report to the governor on all essential matters with regard to mining in the state."(AS 27.05.060). The report is the 35th annual minerals report (dggs.alaska.gov/pubs/minerals). Distribution of more than 900 print copies and 108 downloads of the annual report during 2015 indicate that this is a vital publication.

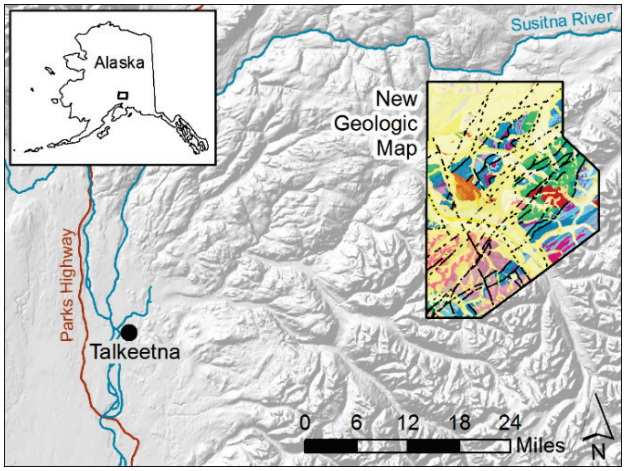


Alaska is perennially recognized as having mineral-resource potential and a healthy mining economy equivalent to many countries, but competes for international mineral-exploration investment with neighboring Canadian provinces and other U.S. states that have more developed infrastructure and are perceived as having lower risk. The annual Mineral Industry Report and the presentations about Alaska's 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, Nevada, and Arizona as well as many countries.

Alaska mineral resources 2013, by L.K. Freeman, 2014: Alaska Division of Geological & Geophysical Surveys Miscellaneous Publication 152, 1 sheet, scale 1:63,360. doi:10.14509/27082

Alaska's mineral industry 2014, by L.K. Freeman, J.E. Athey, P.S. Lasley, and E.J. Van Oss, 2015: Alaska Division of Geological & Geophysical Surveys Special Report 70, 60 p. doi:10.14509/29515

It's Not Our Fault: Talkeetna Mountains Map Fills Geologic Gap and Defines New Fault



Preliminary geologic map of the Talkeetna Mountains C-4 Quadrangle and adjoining areas (PIR 2015-6).

Geologic maps are an important source of information for land managers, mineral-resource exploration companies, and for engineers making design decisions. The DGGS Mineral Resources section filled a significant gap in Alaska's detailed geologic map coverage when it published a new, 450 mi^2 map of part of the Talkeetna Mountains in July 2015. The new map and report, PIR 2015-6, is the result of six weeks of fieldwork and more than 1,600 supporting laboratory analyses including chemical compositions and radiometric ages of rock samples.

Our work found that previously undocumented rock types favorable to both nickel–copper–platinum and copper–gold–silver mineral deposits occur in the area; this information should attract follow-up exploration and possibly new mineral discoveries. Platinum is of particular interest because of its critical role in modern technology as well as insufficient U.S. production.

Structurally-controlled Triassic copper mineralization (green staining) along a newly discovered fault zone in the Talkeetna Mountains map area.

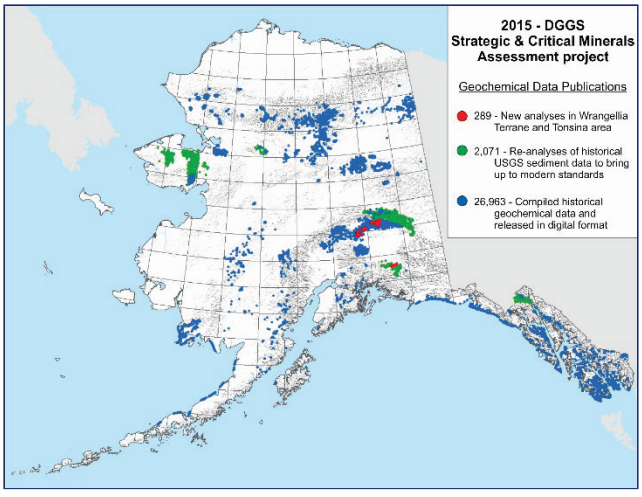
Additionally, the map defines a new fault that appears to explain the origin and distribution of a 25-mile-long belt of copper-, gold-, and silver-bearing mineral occurrences. Detailed groundwork, together with analysis of the DGGS's airborne geophysical surveys, shows that the map area is cut by numerous previously unrecognized faults, with major fault activity taking place 62 to 37 million years ago. This information will help engineers assess the possible seismic hazards faced by proposed hydropower development in the region.

Geologic map of the Talkeetna Mountains C-4 Quadrangle and adjoining areas, central Alaska, by Evan Twelker, T.D. Hubbard, Alicja Wypych, K.R. Sicard, R.J. Newberry, D.A. Reioux, L.K. Freeman, and L.L. Lande, 2015: Alaska Division of Geological & Geophysical Surveys Preliminary Interpretive Report 2015-6, 16 p., 1 sheet, scale 1:50,000. doi:10.14509/29470

Strategic & Critical Minerals (SCM) Assessment: Geochemistry—An Important Key!

Alaska's Strategic and Critical Minerals (SCM) Assessment project evaluates Alaska's 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. One objective of the SCM project is to improve Alaska's publicly available geochemical database, which is essential for screening broad areas of Alaska for their mineral content and identifying areas with SCM potential. The quality of much of the available analytical data hinders its use for this type of assessment.

In 2015, DGGS published 289 new, SCM-related geochemical analyses from the south-central Alaska Range and Tonsina area, and compiled digital geochemical data for 26,963 historical samples (see figure). DGGS also coordinated with the USGS and conducted a statewide GIS- and watershed-based analysis to identify areas with SCM potential, created a Geochemical Atlas of Alaska, and reanalyzed 2,071 historical USGS sediment samples, upgrading them to modern analytical standards.



These geochemical datasets and derivative products are being used to help define Alaska's mineral belts. This work will advance the State's knowledge of its geologic resources; promote informed State, Federal, and Alaska Native corporation land- and resource-management decisions; guide the more-detailed industry exploration work necessary to make economic mineral discoveries; and spur industry investment and mineral development to help diversify Alaska's economy and increase state revenue.

Geochemical reanalysis of historical U.S. Geological Survey sediment samples from the northeastern Alaska Range, Healy, Mount Hayes, Nabesna, and Tanacross quadrangles, Alaska, by M.B. Werdon, Matthew Granitto, and J.S. Azain, 2015: Alaska Division of Geological & Geophysical Surveys Raw Data File 2015-7, 6 p. doi:10.14509/29451

Geochemical analyses of rock samples from the Tonsina area, Valdez Quadrangle, Alaska, by M.B. Werdon, 2015: Alaska Division of Geological & Geophysical Surveys Raw Data File 2015-17, 3 p. doi:10.14509/29519

NOTABLE ACHIEVEMENTS

- Completed the third-year fieldwork portion of a multi-year strategic and critical mineral copper–nickel–cobalt platinum-group-element assessment of 2,600 mi^2 in the Wrangellia geologic province of south-central Alaska by conducting ore deposit research, mapping compilation, and new geologic mapping of the Triassic-age mafic rocks that are potential hosts to mineralization.
- Published airborne geophysical survey data for 989 mi^2 in the Tok area, east-central Alaska, adjacent to previous Alaska Highway corridor and Slate Creek–Slana River airborne geophysical surveys.
- Published airborne geophysical survey data for a 266 mi^2 Strategic and Critical Minerals-related survey near Tonsina, on the north side of the Chugach Mountains along the Richardson Highway in south-central Alaska.
- Completed a second year of reconnaissance geologic mapping and physical properties sampling

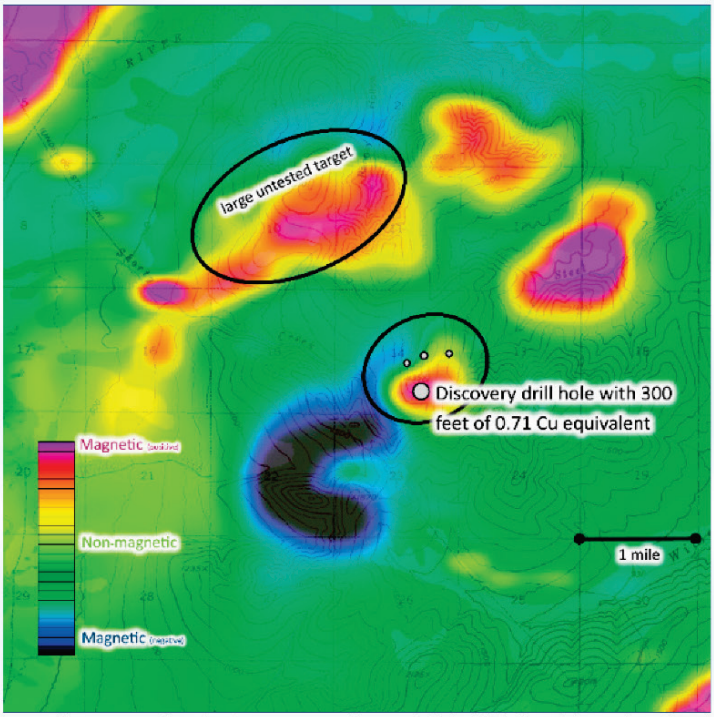
in the 266 mi^2 Tonsina airborne geophysical survey area.

- Supported the Division of Mining, Land and Water and the U.S. Bureau of Land Management by providing extensive mineral-resource reviews for area plans and State land sales.
- Provided mineral-resource-potential evaluations of State land throughout Alaska, to identify and prioritize appropriate land to relinquish from the State of Alaska's overselected land entitlement.
- Presented four posters and eight talks at professional meetings.
- Responded to more than 400 public, industry, and agency requests for mineral-resource information.

Merrill Pass pluton, Styx River map area. Rusty weathering area on right is hornfelsed Cretaceous sediments in margin of pluton.

DGGS GEOPHYSICAL DATA FACILITATES COPPER DISCOVERY

With drilling targeted in part on a magnetic anomaly delineated in DGGS geophysical data, mineral exploration company Freegold Ventures Ltd. this year announced the potential for a significant copper and gold discovery in the Shorty Creek area, 50 miles northwest of Fairbanks (press release, November 16, 2015). Drilling highlights include a 300-foot-thick intercept of mineralization averaging 0.55 percent copper and 0.14 parts per million gold, along with favorable geologic indicators including intense alteration, quartz–sulfide veining, and quartz–feldspar porphyry intrusions. In their press release announcing the find, Freegold states that coincident magnetic and geochemical anomalies offer the most favorable targets.



Freegold Ventures Ltd. exploration targets (outlines) and 2015 drill holes (circles) (adapted from Freegold press release, November 16, 2015) with DGGS Livengood survey magnetic data and USGS 1:63,360-scale topographic map. DGGS magnetic data, along with other data, are being used for targeting. Discovery drill hole 3 encountered 300 feet of copper–gold–silver mineralization with values equivalent to 0.71 percent copper.

The DGGS Livengood geophysical survey (doi: 10.14509/29412) used in Freegold's exploration 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 program in 1993, DGGS has collected high-quality magnetic and electromagnetic data covering more than 30,000 mi² of Alaska land with high mineral-resource potential; these geophysical surveys have been one of DGGS's most valuable and sought-after data products.

Another important component of the program is the creation and publication of geologic maps and reports. In 2004, DGGS published a geologic map of the Livengood area (doi:10.14509/3310) immediately north of Freegold's Shorty Creek project. This map and the DGGS Livengood geophysical survey helped to attract exploration investment by AngloGold Ashanti and International Tower Hill Mines, which led to the 2006–2013 discovery of the large, 20-million-ounce Money Knob gold deposit. DGGS continues to work in the area and will release a new geologic map covering Livengood and Shorty Creek in early 2016.

Tools of the trade—shovel, hammer, and magnetic susceptibility meter—are supplemented with airborne geophysical data to make new geologic maps to spur mineral investment.

Steam from the summit of Shishaldin volcano on August 19, 2015.

BENEFIT TO ALASKA

The DGGS Volcanology section combines volcanology expertise and advanced skills in database and web-based information distribution to efficiently respond to unrest and eruptions at Alaska's 52 historically active volcanoes. In the past 8 years, there have been 17 eruptions at eight Alaska volcanoes; ash in the atmosphere resulted in hundreds of flight cancellations, thousands of displaced passengers, and mudflows that temporary closed oil storage and transport facilities in Cook Inlet. As a partner in the interagency Alaska Volcano Observatory (AVO), Volcanology Section staff continue to play a lead role in communication of volcanic unrest and activity, managing information flow both within the observatory and out to the public, and conducting geologic studies to improve our understanding of past eruptive activity.

Cheryl Cameron, Scott Crass, Janet Schaefer

What is the Likelihood of an Eruption?
Tools in Volcano Hazard Assessment

Geologic mapping, geochemical analyses, detailed time-stratigraphic studies of volcanic deposits, and web-based databases of unrest and eruption provide data on the character, dispersal patterns, frequency, and magnitude of volcanic eruptions, all of which are necessary to more accurately assess and communicate volcanic hazard. The DGGS Volcanology Section conducts geologic studies of active volcanoes and provides this information, along with volcano monitoring observations, to both scientists and the public, in a web-based, searchable format allowing for rapid, interagency, fact-based decision making to efficiently communicate volcano hazard information and science to a worldwide audience.

We Kick Ash: Monitoring, Hazard Communication, and Field Logistics

Janet Schaefer (AVO/DGGS) describes Makushin's past eruptions to Harold Montgomery of the Ounalashka Corporation, and discusses impacts to Dutch Harbor/Unalaska if Makushin produces similar-sized eruptions in the future.

During 2015, Volcanology Section staff responded to unrest at Pavlof, Semisopochnoi, Cleveland, Shishaldin, and Veniaminof volcanoes by participating in seismic and remote-sensing watches, answering emails and phone calls from the public, and accurately and efficiently distributing volcanic activity information through the DGGS-managed AVO website (avo.alaska.edu), Facebook (facebook.com/alaska.avo), and Twitter (@alaska_avo) sites. Our AVO public website receives more than 70,000 unique visitors per month, and our Facebook page has doubled in popularity since last year, now with 5,000 likes. In addition, we answered more than 200 emails from the public through our AVO website email interface, and our Twitter feed has 13.8 thousand followers, 500 more than last year.

Janet Schaefer (AVO/DGGS) and Jim Vallance (USGS) examine tephra (ash) deposits from Makushin volcano in a peat-rich outcrop. Metadata, field images, and chemistry results from these samples are entered directly into the Geologic Database of Information on Volcanoes of Alaska (GeoDIVA).

This year, AVO scientists and collaborators spent more than 100 days in the field repairing monitoring equipment, installing new instruments, conducting geologic mapping, and collecting gas, tephra, and rock samples. DGGS managed the helicopter contracts and budget for this fieldwork, which included visits to volcanoes across 1,500 miles—from Mt. Spurr in Cook Inlet to Kiska volcano in the far western Aleutians.

A Database *Can* Have a Clever Name: Geologic Database of Information on Volcanoes of 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. In 2015, significant updates to GeoDIVA included: (1) the expansion of the on-line volcano reference library, currently containing ~4,900 references, (2) additions to the eruption histories of Cleveland, Veniaminof, and Pavlof volcanoes to include a timeline of events and impacts of the 2014 and 2015 eruptions, (3) expansion of the image database, now with 23,500 images, (4) metadata for more than 13,350 geologic samples, and (5) additions to the geochemical database of volcanic rocks of Alaska, bringing the totals to more than 7,500 whole rock analyses, 118 water chemistry analyses, and 530 glass analyses. AVO's geochemical database is available as a DGGS publication (DDS 8, avo.alaska.edu/geochem). A new GeoDIVA module to hold remote sensing satellite and web-camera observations was created and now contains entries for nearly all observations from 2015. Having these observations in a database allows AVO staff to easily search reports of volcanic activity, such as thermal anomalies, ash in the atmosphere, and steaming, leading to accurate and consistent analysis of the state of unrest at each volcano.

Ash Clouds up to 52,000 Feet: New Report on Okmok's 2008 Eruption

In 2015, we published *The 2008 phreatomagmatic eruption of Okmok Volcano, Aleutian Islands, Alaska: Chronology, Deposits, and Landform Changes* (DGGS Report of Investigations 2015-2). The eruption lasted five weeks, producing 0.35 km^3 of fine-grained tephra (ash) that covered most of northeastern Umnak Island.

Water-rich ash jets from multiple vents during an explosion at Okmok volcano on August 2, 2008.

The eruption created a new vent complex in the caldera, culminating in the construction of a 300-meter-high tephra cone. Cloud heights reached 52,000 feet in the opening phase of the eruption.

Several Aleutian communities were cut off from air travel for many weeks due to nearly constant ash production and disruption of flight routes in the region. Unalaska/Dutch Harbor was dusted with ash on several occasions and the ash, gas, and aerosol cloud from the July 12 event temporarily disrupted air traffic across the North Pacific and was visible to pilots in the lower 48 states several days later. This publication highlights the hazards and depositional products associated with the interaction of ascending magma and extensive shallow groundwater.

NOTABLE ACHIEVEMENTS

- The Alaska Tephra Database has seen significant growth in the last year, with programming advancements that allow easier upload of new data, the calculation of similarity coefficients, and the ability to compare glass data to more than 500 separate analyses.
- AVO/DGGS joined an international Ash Impacts Database group, dedicated to creating a global database of information on volcanic ash impacts to people, property, and the environment. Ash impact information stored in a searchable database will improve warning messages, public and lifeline emergency preparation, and eruption response and recovery.
- Began a collaborative effort with the USGS Volcano Disaster Assistance Program, contributing data on Alaska volcanoes to the Eruption Forecasting Information System (EFIS) database. GeoDIVA's table structure is being used to store information on unrest leading to both eruptions and failed eruptions. By contributing and having access to a worldwide dataset of unrest and precursory signals, AVO scientists are better able to make informed statements regarding the potential for volcanic activity.
- The final season of fieldwork for the Makushin volcano Holocene (within the last 10,000 years) eruptive history project was completed this year. Geologists are currently processing samples and interpreting stratigraphy that will result in a refined look at the volcanic hazards faced by the Dutch Harbor/Unalaska community.

VOLCANOLOGY SECTION PUBLICATIONS IN 2015

"Is Ash Falling?", an online ashfall reporting tool in support of improved ashfall warnings and investigations of ashfall processes, by K. Wallace, S. Snedigar, and C. Cameron, 2015: Journal of Applied Volcanology, v. 4, no. 8, 10 p. doi:10.1186/s13617-014-0022-6

2013 Volcanic activity in Alaska—Summary of events and response of the Alaska Volcano Observatory, by J.P. Dixon, Cheryl Cameron, R.G. McGimsey, C.A. Neal, and Chris Waythomas, 2015: U.S. Geological Survey Scientific Investigations Report 2015-5110, 92 p. doi:10.3133/sir20155110

Jumbo Dome, Interior Alaska—Whole-rock, major-, and trace-element analyses, by C.E. Cameron, C.J. Nye, K.F. Bull, and Rebecca-Ellen Woods, 2015: Alaska Division of Geological & Geophysical Surveys Raw Data File 2015-14, 3 p. doi:10.14509/29520

The 2008 phreatomagmatic eruption of Okmok Volcano, Aleutian Islands, Alaska—Chronology, deposits, and landform changes, by J.F. Larsen, C.A. Neal, J.R. Schaefer, A.M. Kaufman, and Zhong Lu, 2015: Alaska Division of Geological & Geophysical Surveys Report of Investigation 2015-2, 53 p. doi:10.14509/29405

Aleutian Arc geothermal fluids—Chemical analyses of waters and gases sampled in association with the Alaska Volcano Observatory, by W.C. Evans, D. Bergfeld, C.A. Neal, R.G. McGimsey, C.A. Werner, C.F. Waythomas, J.L. Lewicki, T. Lopez, M.T. Mangan, T.P. Miller, A. Diefenbach, J. Schaefer, M.L. Coombs, B. Wang, K. Nicolaysen, P. Izbekov, Z. Maharrey, M. Huebner, A.G. Hunt, J. Fitzpatrick, and G. Freeburg, 2015: U.S. Geological Survey Data release. doi:10.5066/F78G8HR1

A LITTLE BACKGROUND INFORMATION

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, the State Geologists have been selected from lists of candidates prepared by the geologic community and professional societies within Alaska. A department order in 2002 formalized a process whereby the Geologic Mapping Advisory Board oversees evaluation of candidates and provides a list to the Commissioner. The qualifications and responsibilities of the State Geologist and the mission of DGGS are defined by statute.

Director's Office

The Director's Office provides strategic planning for the Division's programs to ensure that DGGS is meeting the needs of the public under the guidelines of AS 41.08.020, manages the Division's fiscal affairs, and provides personnel and administrative services.

From left: Linda Natrop, Ken Papp, Shelly Showalter, Steve Masterman, April Woolery.

The Director acts as a liaison between the Division and local, State, federal, and private agencies; seeks out and encourages cooperative geologic programs of value to the State; and advises the Commissioner of the Department of Natural Resources about geologic issues.

Statutory Authority

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

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

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

Sec. 41.08.030. Printing and distribution of reports. The state geologist shall print and publish an annual report and such other special and topical reports and maps as may be desirable for the benefit of the State, including the printing or reprinting of reports and maps made by other persons or agencies, where authorization to do so is obtained. Reports and maps may be sold and all money received from these sales shall be paid into the general fund. (1 ch 93 SLA 1972)

Locations

Division of Geological & Geophysical Surveys offices, 3354 College Road, Fairbanks

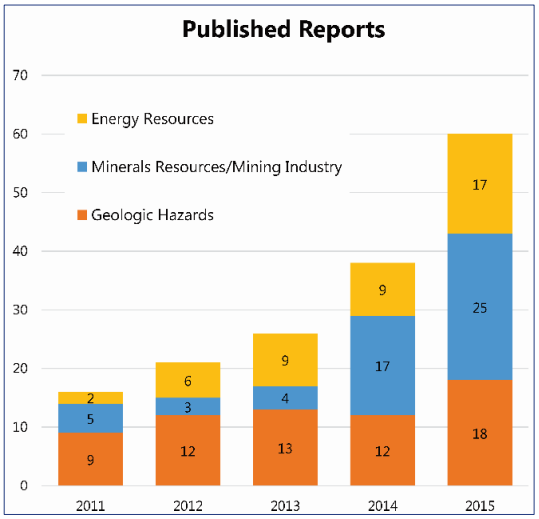
The Division's administrative headquarters and staff moved from Anchorage to Fairbanks in 1987.

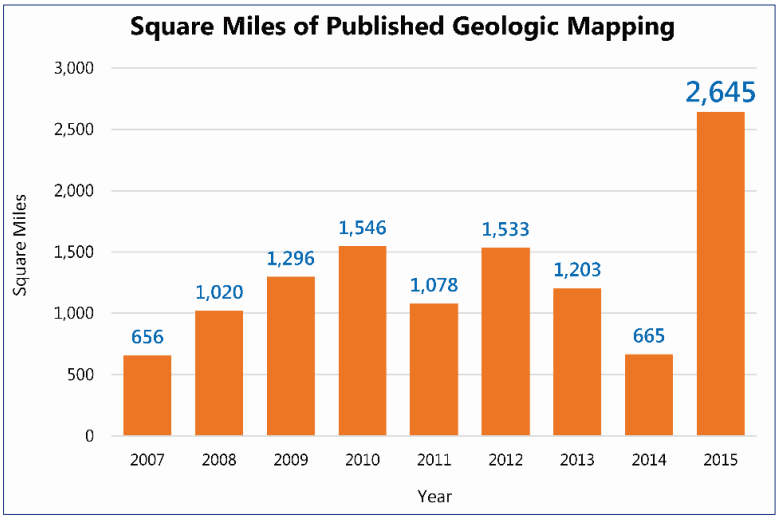
The close proximity of the Division to the earth science research laboratories of the University of Alaska Fairbanks campus has a strategic benefit to the DGGS program as well as UAF. University faculty and students are important adjunct members of many DGGS project teams.

The Alaska GMC, located at 3651 Penland Parkway in Anchorage, is the central repository in which geologic materials collected from Alaska are cataloged, stored, and studied. The center is permanently maintained and managed by the State of Alaska with support from cooperating government agencies that include the USBLM, USGS, USBOEM, AOGCC, and private industry.

Alaska Geologic Materials Center, 3651 Penland Parkway, Anchorage

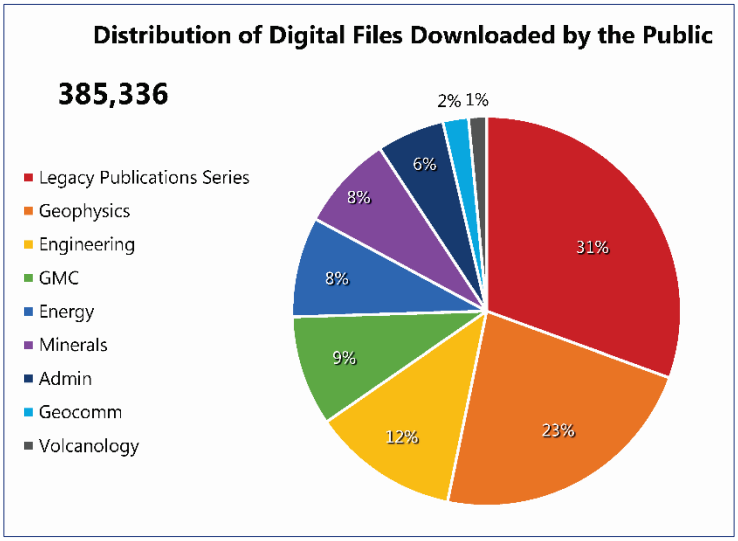
PERFORMANCE MEASURES

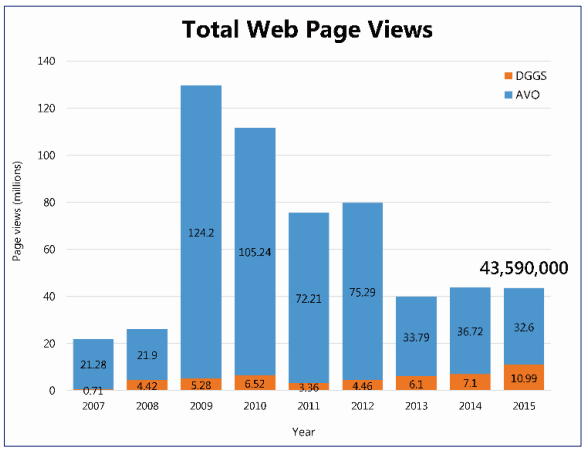




TOP 10 MOST VISITED DGGS WEBSITES

1. Elevation Datasets in Alaska
   http://maps.dggs.alaska.gov/elevation
2. Alaska Shoreline Change Tool
   http://maps.dggs.alaska.gov/shoreline
3. Quaternary Faults and Folds (QFF)
   http://maps.dggs.alaska.gov/qff
4. DGGS Homepage
   http://dggs.alaska.gov
5. Interactive Maps Homepage
   http://maps.dggs.alaska.gov
6. Geologic Map Index of Alaska
   http://maps.dggs.alaska.gov/mapindex
7. DGGS Publications Search
   http://dggs.alaska.gov/pubs/pubs
8. Historically Active Volcanoes of Alaska
   http://maps.dggs.alaska.gov/historically_active_volcanoes
9. Airborne Geophysics
   http://maps.dggs.alaska.gov/gp
10. Alaska Geologic Data Index
    http://maps.dggs.alaska.gov/agdi





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 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 receiving 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 Coastal Impact Assistance Program (CIAP). The NGGDPP, funded by the USGS, has supported several DGGS projects to preserve and make geologic information publicly available. DGGS received major multi-year CIAP support through a highly competitive proposal process currently administered by the U.S. Fish & Wildlife Service. CIAP funding has supported geologic mapping and hazards evaluations of coastal communities in Alaska that face current risks from coastal erosion and storm-wave flooding.

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 multifold. 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. The members solicit and welcome comments and suggestions from the public concerning state needs and DGGS programs throughout the year.

Current and new (marked with *) 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, 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.

Lance Miller

Vice President for Resources, Nana Regional Corporation

Dr. Miller has strong mineral industry experience and also represents Alaska Native corporation interests.

Anupma Prakash*

Co-Chair of the University of Alaska Fairbanks Department of Geosciences

Dr. Prakash has a background in remote sensing in the Arctic. She will represent the University of Alaska in the areas of geology and geophysics, remote sensing, and Arctic geoscience research.

Gregory Wilson*

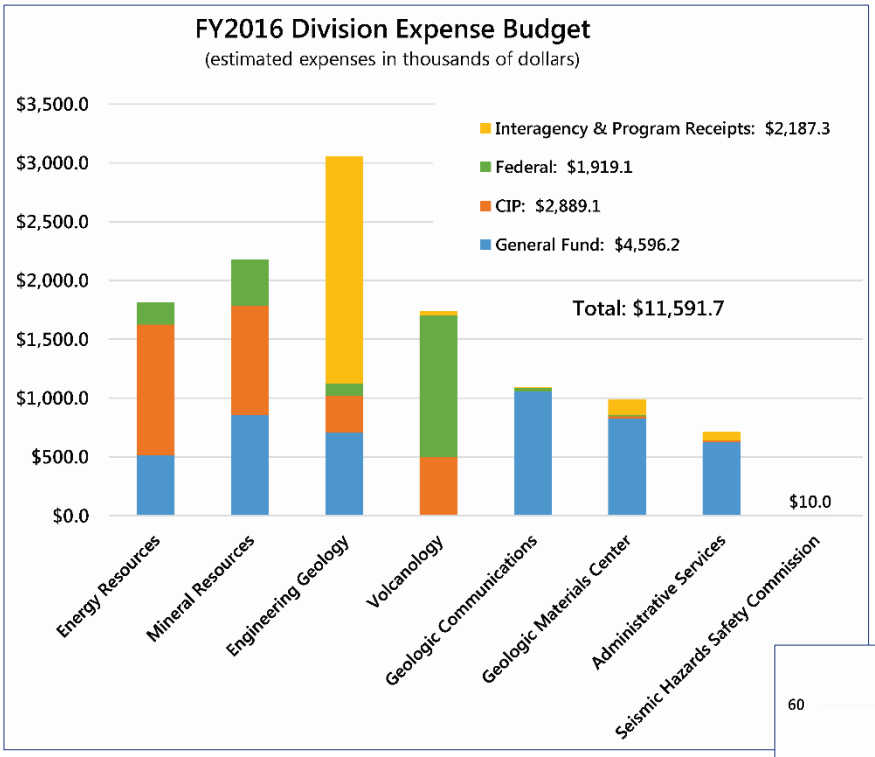
Director Arctic Exploration and Services, ConocoPhillips Alaska

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

Thank you, Dr. Paul Layer!

This year DGGS and the Board said farewell to Dr. Paul Layer, Dean of the School of Natural Sciences at the University of Alaska, Fairbanks. Paul has served on the board since 1999, and during that time DGGS has benefited greatly from his well-reasoned and sound advice. We wish to heartily thank you, Paul, for your service to this organization, and by extension, the state. We are sorry to lose you to the increasing demands of your University position, but wish you well in your future endeavors and look forward to continuing the long and close relationship between our organizations.

FINANCES


FY2016 Division Expense Budget
(estimated expenses in thousands of dollars)
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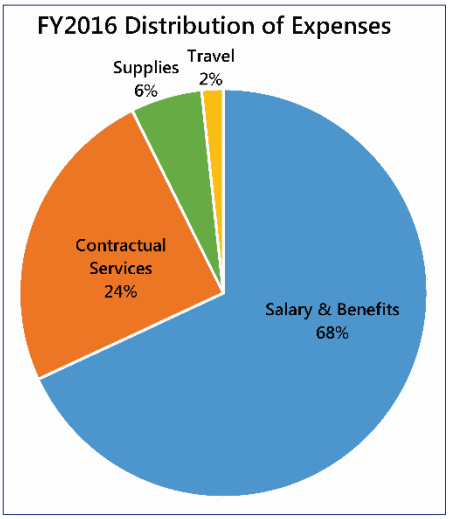
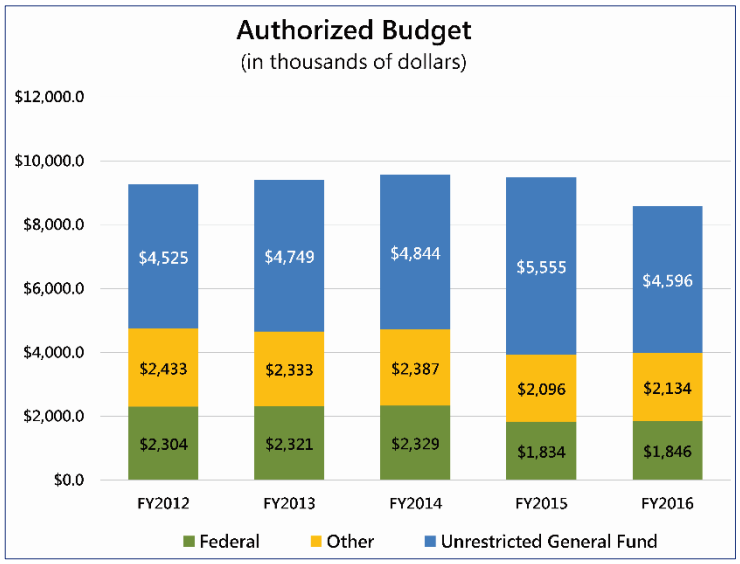
$3,000.0
$2,500.0
$2,000.0
$1,500.0
$1,000.0
$500.0
$0.0
Interagency & Program Receipts: $2,187.3
Federal: $1,919.1
CIP: $2,889.1
General Fund: $4,596.2
Total: $11,591.7
$10.0
Energy Resources
Mineral Resources
Engineering Geology
Volcanology
Geologic Communications
Geologic Materials Center
Administrative Services
Seismic Hazards Safety Commission


FY2016 Distribution of Expenses
Supplies 6%
Travel 2%
Contractual Services 24%
Salary & Benefits 68%


Authorized Budget
(in thousands of dollars)
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$10,000.0
$8,000.0
$6,000.0
$4,000.0
$2,000.0
$0.0
$4,525
$4,749
$4,844
$5,555
$4,596
$2,433
$2,333
$2,387
$2,096
$2,134
$2,304
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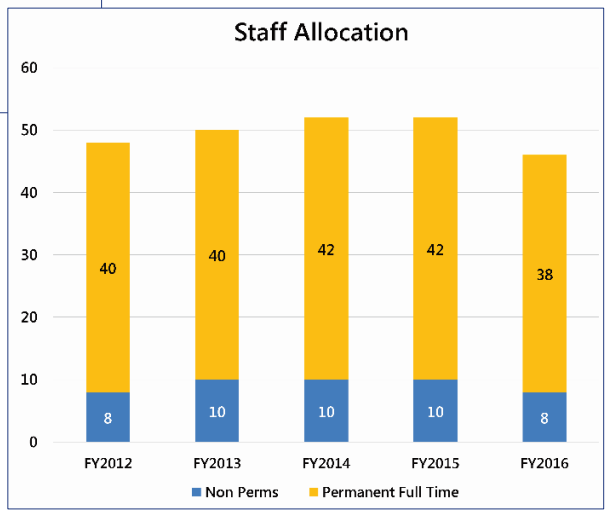
FY2012
FY2013
FY2014
FY2015
FY2016
Federal
Other
Unrestricted General Fund


Staff Allocation
60
50
40
30
20
10
0
40
40
42
42
38
8
10
10
10
8
FY2012
FY2013
FY2014
FY2015
FY2016
Non Perms
Permanent Full Time

EMPLOYEE TRANSITIONS

Laurel Burns

Retirement

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

Laurel began working for the Alaska Division of Geological & Geophysical Surveys as a Geological Assistant for summer field projects in summer 1979, and continued each summer until she became a full-time geologist in June 1983. Laurel spent 10 years at DGGS carrying out geologic field mapping in various places in Alaska, probabilistic mineral-resource modeling, and geochemical statistical studies. She was an invited participant in a U.S.–U.S.S.R. cooperative project on mafic and ultramafic rocks in the Soviet Far East in 1990 and 1991. Since 1993, she developed and managed the then-new Alaska Airborne Geophysical/Geological Mineral Inventory (AGGMI) Program, designed to acquire geophysical data and geological mapping on 40 million acres of State interest lands with perceived mineral potential.

Laurel was chief of the Minerals Section for 7 years, retiring as a Geologic Scientist I with a specialty in airborne geophysical data. Statistics of her career at DGGS are impressive: 535 publications, of which she was lead author on 448; the work covered 27,900 mi^2 in 44 individual State and federally funded surveys. It's estimated that 50 percent of annual mining claim rental revenues come from areas covered by the AGGMI surveys that Laurel oversaw.

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

Jim Clough

Retirement

After 34 years of state service, geologist Jim Clough retired in June 2015. Jim grew up in Ohio and earned a B.A. in Geology from The College of Wooster in 1975. He moved to Alaska in the mid-1970s to pursue graduate studies at the University of Alaska Fairbanks, where he earned his M.S. in Geology in 1981. Jim first worked for DGGS as an intern in 1978 and joined the organization as a full-time employee in January 1981. He served as chief of the Energy Resources Section from 1995 to 2006 and as a Geological Scientist I from 2006 until his retirement.

Jim's main area of expertise was carbonate sedimentology and he worked on carbonate successions throughout Alaska, including Neoproterozoic and early Paleozoic rocks in the range-front region of ANWR, Devonian carbonates in east-central Alaska, and Ordovician and Devonian carbonates in Lime Hills and Sleetmute quadrangles in southwestern Alaska. In recent years Jim's geological focus expanded to include paleo tectonic reconstruction of northern Alaska. Jim also served as DGGS's expert on Alaska's coal resources and CO_2 sequestration. Jim

has a passion for languages and culture and is fluent in Yup'ik and Russian. In retirement he hopes to complete his Ph.D. in Geology at the University of Alaska Fairbanks.

Scott Crass

Welcome to DGGS!

Scott Crass, an Analyst/ Programmer IV, began working for the DGGS Volcanology Section in September of this year. Scott serves as the lead programmer for the Volcanology Section and the interagency Alaska Volcano Observatory (AVO), designing and implementing web-based information distribution and data handling systems for both the AVO public and internal websites.

For the past 15 years, Scott has worked with scientists, helping them to publish content and share data over the web—first with Northern Land Use Research Alaska, and more recently with the Alaska Department of Fish and Game.

Scott is a lifelong Alaskan and avid skier, and enjoys hunting, fishing, and Kung Fu movies. He returned to Fairbanks after living in Juneau on his boat, the Airloom, and is building a home with his wife, Trista, and children, Earl and Marigold. We welcome Scott to the DGGS/AVO team.

Linda Natrop

Welcome to DGGS!

Linda Natrop joined DGGS in September 2015 as a Natural Resource Technician II. The position includes duties formerly assigned to our Office Assistant II position, which was deleted in FY16 budget reductions. You'll find Linda in group photos of both the Director's Office section and the Geologic Communications Section.

Linda grew up in southern California and northern Nevada. In 1978, the family moved to Albuquerque, New Mexico, where she later attended the University of New Mexico. Linda moved back to northern Nevada in 1985, married, and had two children.

In 2002, Linda and her family decided it was time for an adventure and they chose Alaska as the location to transplant their roots. Linda went back to school and earned her Associate's Degree at the University of Alaska Fairbanks in 2004. Following graduation she began her career with the State of Alaska as an Office Assistant at the Fairbanks Public Health Center and was Office Assistant II at the Right-of-Way Office with Department of Transportation & Public Facilities from 2012 until she accepted the position at DGGS in 2015.

Outside of work, Linda enjoys traveling with her husband, hanging out with her grandson, spending time with her son and his wife, crocheting, rubber stamping, fishing, and fitness activities. She is involved in music, church activities, and suicide prevention events.

Joyce Outten

Retirement

After her second stretch working with DGGS—nearly 13 total years of service—first as a Publications Technician II, and this time as a Natural Resources Technician II, Joyce Outten finally made the choice to retire at the end of May.

Joyce capably staffed the division's geologic information desk, filled publication orders, interacted with customers, kept the library organized and useful to our staff and visitors, helped geologists find books and other tools they needed for their work, added

new information and fixed errors in our publications database, was always looking for new ways to get our geologic data into the hands of users, and was instrumental in keeping things running smoothly.

But most of all (and on her own time), Joyce showed care to her co-workers by helping them out whenever she could, encouraging camaraderie among staff, arranging (and often cooking for) frequent division lunches and other events, and instituting a well-stocked snack bar, the proceeds of which have been used to celebrate group achievements and holidays. She used her dry, "Maxine"-like sense of humor to keep us entertained and on our toes.

In the 15 years Joyce was gone from DGGS, she worked for Alaska's Air National Guard, where she maintained environmental systems on KC-135s used for refueling missions up and down the west coast. We're sure Joyce was vital to keeping the Guard in shape and our country safe from threats during her time there.

Joyce's many pursuits include caring for her nonagenerian mother, helping with North Pole's Santa's Seniors group (as well as many individual seniors), planting flowers each summer to beautify the North Pole municipal building, participating in the 17 Mile Homemakers Club in North Pole, and completing home improvements.

Our office is just not the same without Joyce. We wish her much happiness and fulfillment in her "retirement", knowing that she will never slow down—she'll just change what she's working on.

Jacquelyn Overbeck

Welcome Back to DGGS!

Jacquelyn Overbeck joined DGGS's Engineering Geology Section this year as manager of the Coastal Hazards Program. Jacquelyn completed her M.S. in Geological Engineering at the University of Alaska Fairbanks while working as a research assistant for DGGS's Coastal Hazards Program. She participated in field excursions to some of the most remote coastal regions of Alaska, helping to collect baseline data and document coastal change.

Jacquelyn spent the last year and a half working with the U.S. Geological Survey in St. Petersburg, Florida, studying storm-induced flooding and erosion for the National Assessment of Coastal Change Hazards. Her research interests include using all levels of remote sensing, from handheld cameras to aerial and satellite imagery, to hydro- and morphodynamic coastal modeling and geomorphic change analyses.

AWARDS AND RECOGNITION

Simone Montayne

Congratulations!

Simone Montayne is a geologist tasked with a variety of duties necessary to provide readily accessible geologic information to our audience and to ensure systematic stewardship of legacy data. Her work includes development and maintenance of our online publications library, organizing modern geospatial data for online distribution and compiling the necessary metadata files, and collecting and cataloging DGGS's continually growing inventory of unpublished historical geologic data.

Simone Montayne accepts the Exceptional Performance Award, Honorable Mention, presented by DNR Commissioner Mark Myers.

Simone was instrumental in developing a streamlined metadata process for DGGS publications. This invigorated a project to digitally release legacy geophysical surveys that was essentially stalled for 18 months. These process improvements were necessary to enable public access to, and ensure the longevity of, a $25 million geophysical data collection that is critical to Alaska resource exploration, transportation, and environmental stakeholders. She has extended this problem-solving attitude to other projects and put significant thought toward reducing future maintenance needs of data archives and publications.

Congratulations to Simone on receiving an honorable mention for exceptional performance, as part of the 2015 Governor's Denali Peak Performance Awards!

De Anne Stevens

25 years of service

As Chief of the Engineering Geology Section, De Anne provides administrative, supervisory, and technical leadership for the Division's geologic hazards and construction materials resources programs and projects. De Anne's main research focus areas are surficial-geologic mapping, Quaternary studies, permafrost and periglacial processes, geologic hazards, construction materials resources, and the use of satellite remote sensing for geologic applications. Although her management duties have kept her fairly closely tethered to her office in recent years, De Anne is still affectionately known to DGGS staff and other surficial geologists as "the chief dirt girl."

During her 25-year tenure with the State (all at DGGS), she has conducted numerous surficial-geologic field mapping and engineering-geology studies throughout Alaska from the Brooks Range to the Kenai Peninsula, and from the Canada border to the Alaska and Seward Peninsulas. Between 1991 and 2015, she has been lead author or co-author on an impressive 169 publications.

De Anne Stevens, the quintessential geologist, ready to dig in the dirt.

De Anne provides technical leadership in Geographic Information Systems (GIS) and satellite data by giving guidance in the use of and access to GIS and spatial image data for scientific analysis and geologic mapping for the entire survey. De Anne regularly provides co-workers with information about grant and outside funding resources for geological research in support of DGGS goals. For years, De Anne has taken a lead role in organizing back-country first-aid training and bear and firearm training courses for field personnel; these training sessions contribute to DGGS's ongoing record of safe field operations.

Many of us often depend on De Anne to take the first step either professionally or personally; she leads by vision and example. Congratulations to De Anne for 25 years of service to the people of the state of Alaska!

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